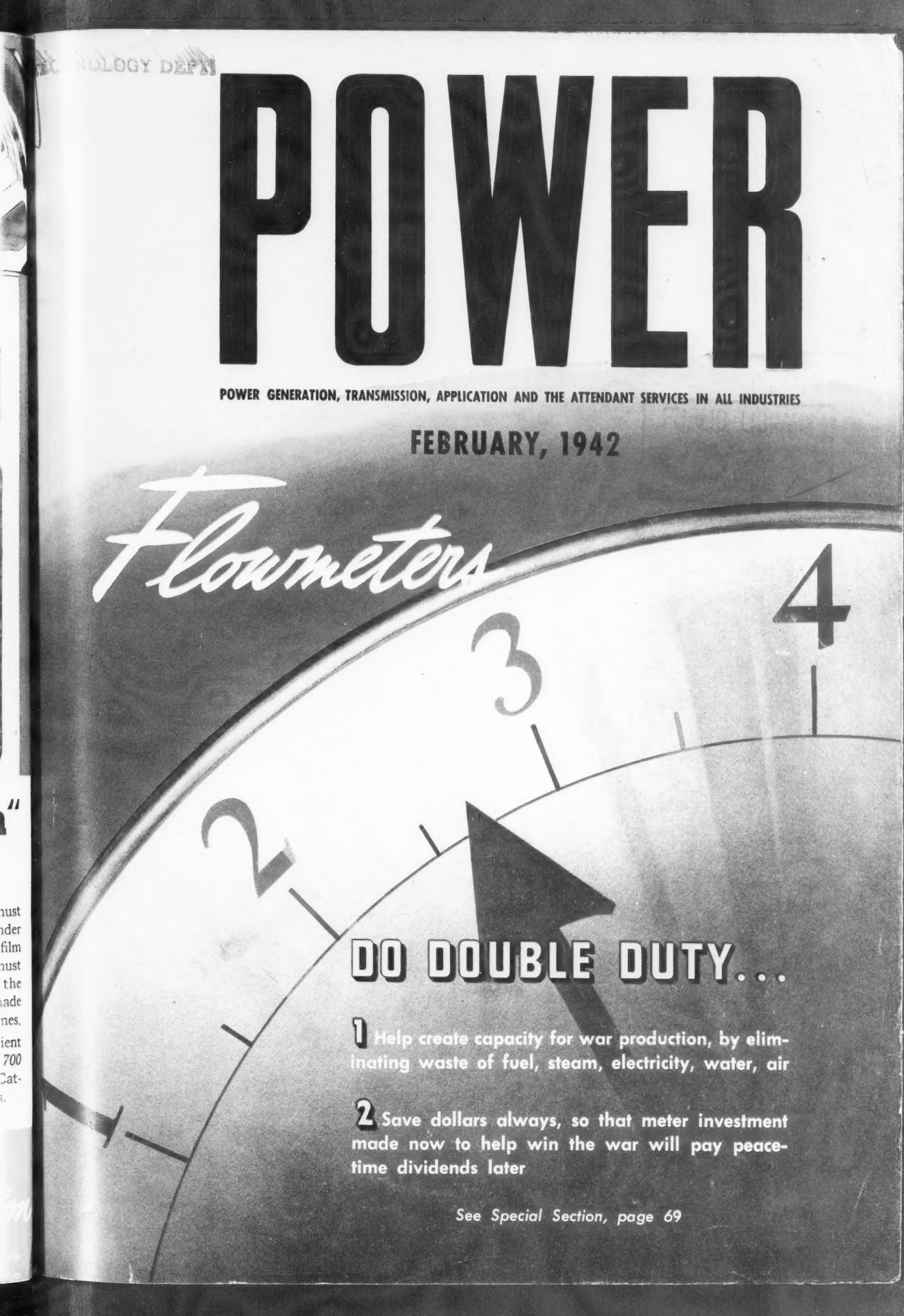
NOLOGY DEPT

POWER

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRIES

FEBRUARY, 1942

Flowmeters

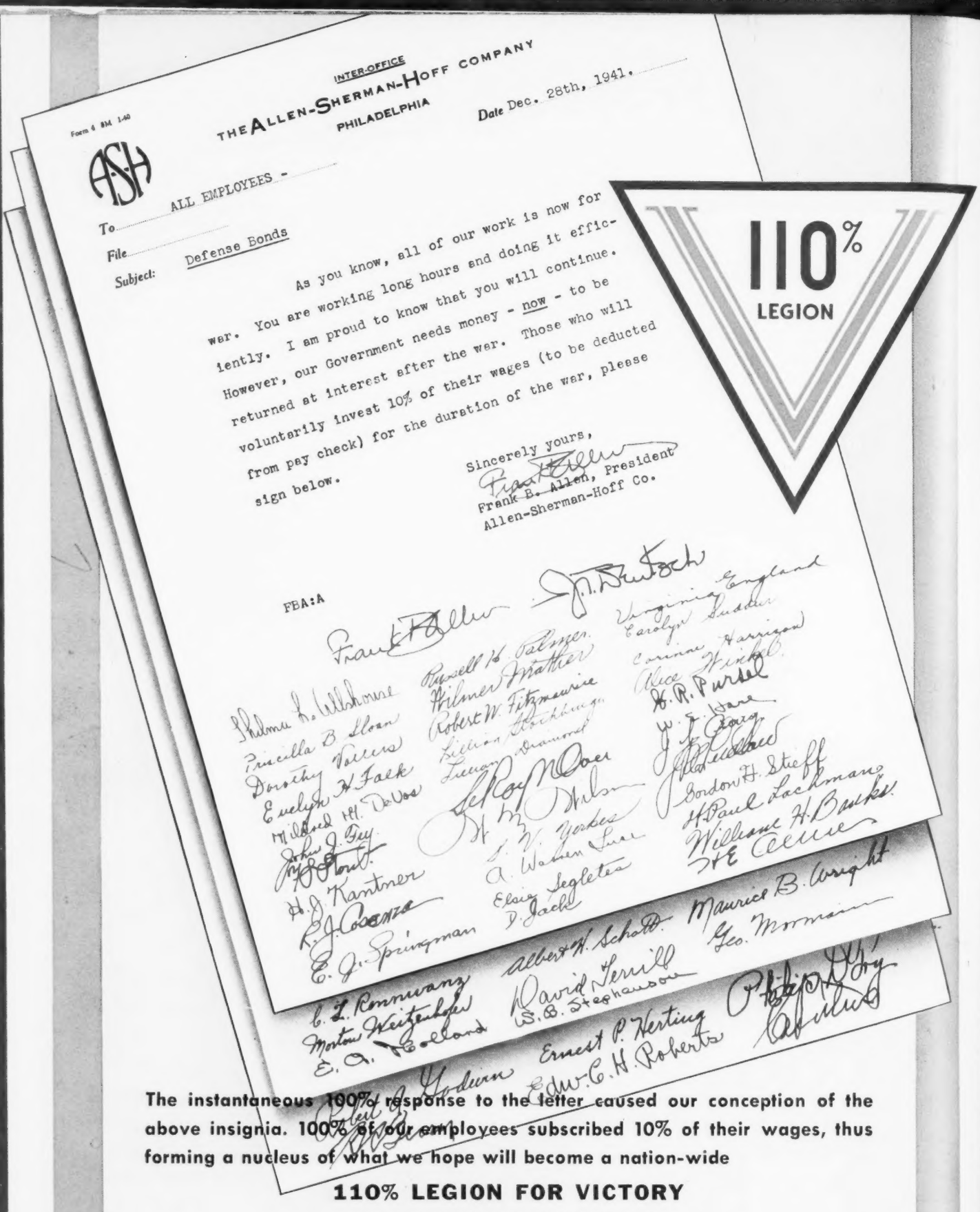


DO DOUBLE DUTY...

1 Help create capacity for war production, by eliminating waste of fuel, steam, electricity, water, air

2 Save dollars always, so that meter investment made now to help win the war will pay peacetime dividends later

See Special Section, page 69


INTER-OFFICE
THE ALLEN-SHERMAN-HOFF COMPANY
PHILADELPHIA
Form 4 BM 1-40
Date Dec. 28th, 1941.
To ALL EMPLOYEES -
File
Subject: Defense Bonds
As you know, all of our work is now for war. You are working long hours and doing it efficiently. I am proud to know that you will continue. However, our Government needs money - now - to be returned at interest after the war. Those who will voluntarily invest 10% of their wages (to be deducted from pay check) for the duration of the war, please sign below.
Sincerely yours,
Frank B. Allen, President
Allen-Sherman-Hoff Co.
FBA:A
110%
LEGION

The instantaneous 100% response to the letter caused our conception of the above insignia. 100% of our employees subscribed 10% of their wages, thus forming a nucleus of what we hope will become a nation-wide

110% LEGION FOR VICTORY IN AMERICAN INDUSTRY

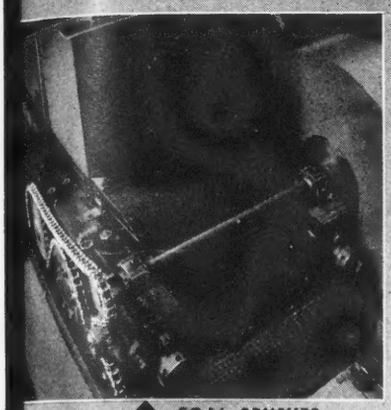
We have adopted this insignia to represent this accomplishment. Our employees will wear it and we proudly display it. Although this design is copyrighted, its use is offered free to any company who will certify that 100% of their employees are accepting 10% of their wages in Defense Bonds. We also have a limited number of insignia buttons that we will forward to those interested. . . . The Allen-Sherman-Hoff Company, 227 South 15th Street, Philadelphia, Penna.

Copyright 1942, The Allen-Sherman-Hoff Co.

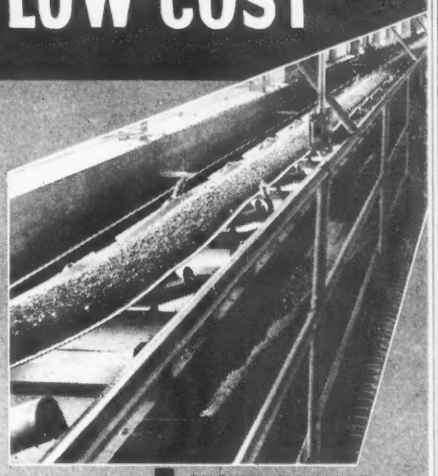
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), February, 1942, Vol. 86, No. 2. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices, 330 West 42nd Street, New York, N. Y. Entered as second class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

Coal IN--Ashes OUT

the LINK-BELT way MEANS Efficiency AND LOW COST



COAL CRUSHER



BELT CONVEYOR

BUCKET ELEVATOR

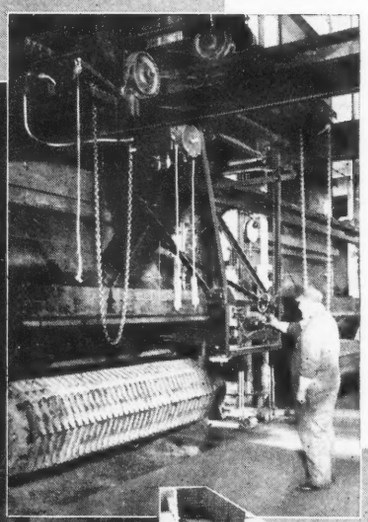
• Getting coal to the fire and ashes away from it, presents one of today's most fertile sources of making economies and increasing efficiency in power plant operation. Link-Belt's nation-wide manufacturing facilities and engineering experience make for quick, expert cooperation with consulting and operating engineers in making economies in all sizes of plants. Send for book No. 1510, "Solving The Problem of Coal and Ashes Handling in the Boiler Plant."

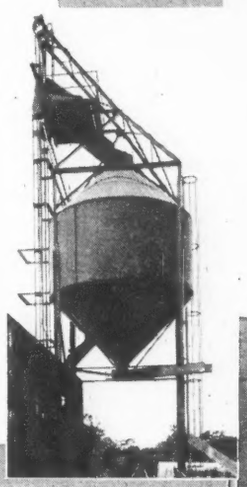
LINK-BELT COMPANY

Engineers and Manufacturers of Materials Handling and Mechanical Power Transmission Machinery Since 1875

Chicago, Philadelphia, Indianapolis, Atlanta, Dallas, San Francisco, Toronto. Offices, warehouses and distributors in principal cities.

8751





WEIGH LARRY

SKIP HOIST

PECK CARRIER

BULK-FLO ELEVATOR-CONVEYOR

CAR SPOTTER

SCREW CONVEYOR

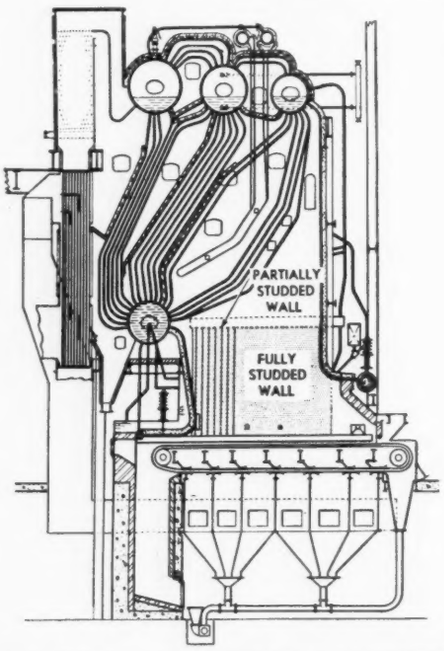
LINK-BELT

. . . Coal And Ashes Handling Equipment

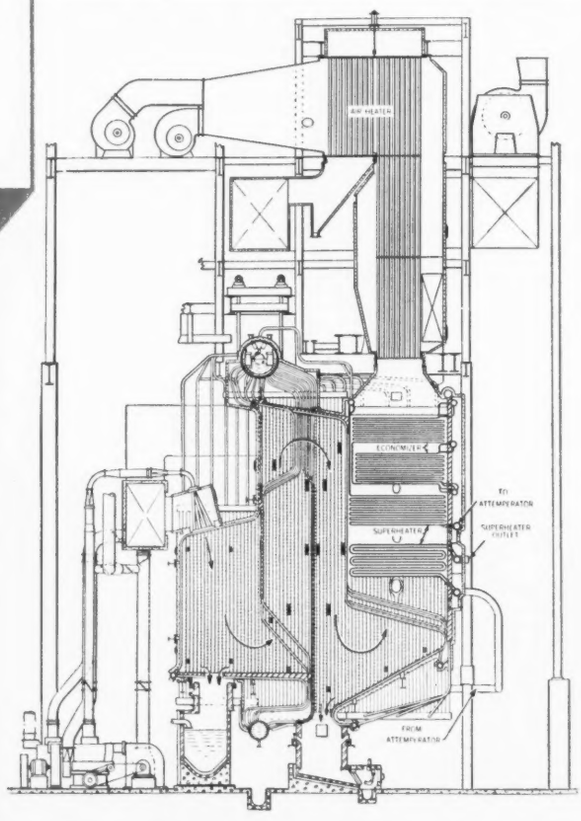
CONVEYORS · ELEVATORS · SKIP HOISTS · CRUSHERS · LARRIES · SCREENS

WATER-COOLING

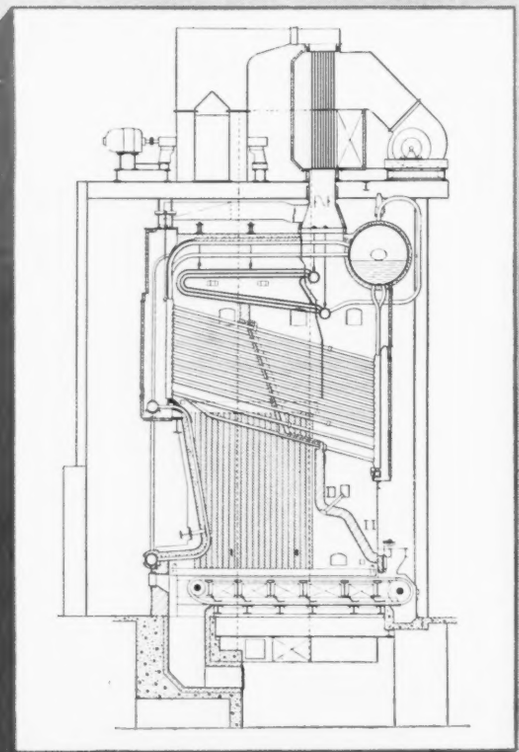
assures



STIRLING BOILER



OPEN-PASS BOILER



B&W CROSS-DRUM BOILER

BABCOCK

OF BOILER FURNACES

Better Service

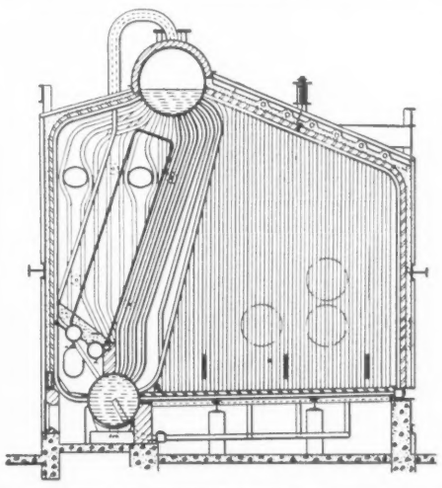
In the all-out defense effort, steam plants in many cases are driven at rates that severely test the reliability of the boiler furnaces. More than ever, therefore, furnace constructions should be of designs and materials that will stand continuous gruelling punishment.

B&W Water-Cooled Furnace Constructions provide a high degree of immunity to operating difficulties under such conditions. They not only meet all requirements of load and structural conditions but also, through their versatility, serve widely varying purposes in different wall areas of individual furnaces. Some areas promote combustion, others temper gases. Some constructions facilitate removal of ash in liquid form, others condition ash for removal in dry form. The fundamental details and safety factors necessary to proper operation are inherent in the designs.

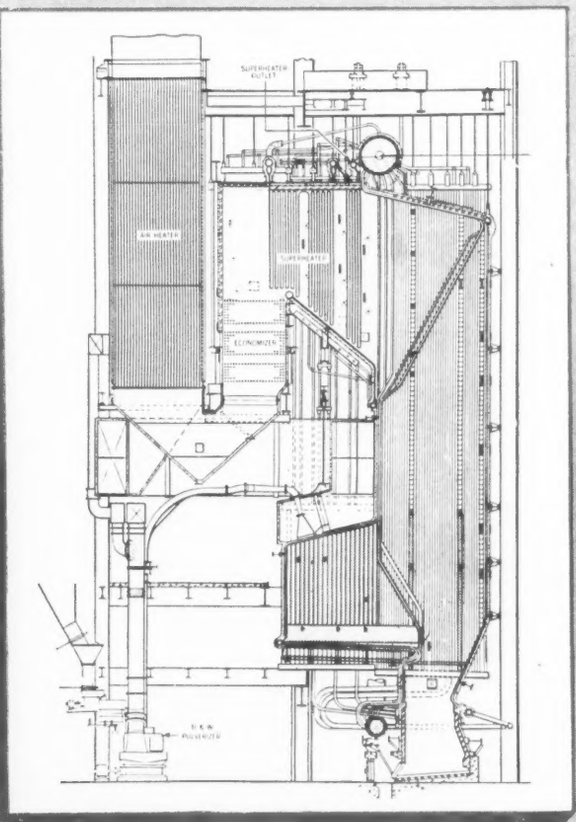
These features are so fundamentally necessary in present-day boilers that they are the basis of the design of the Integral-Furnace, the Radiant, and the Open-Pass Boilers, in which a large portion of the heat absorption takes place in the furnace or in open passes. They are available with other designs of B&W Boilers, to meet exacting operating requirements for all methods of firing.

Complete details are in Bulletin G-16, Water-Cooled Furnaces, available on request.

THE BABCOCK & WILCOX CO.
85 LIBERTY ST. NEW YORK, N. Y.



INTEGRAL-FURNACE BOILER

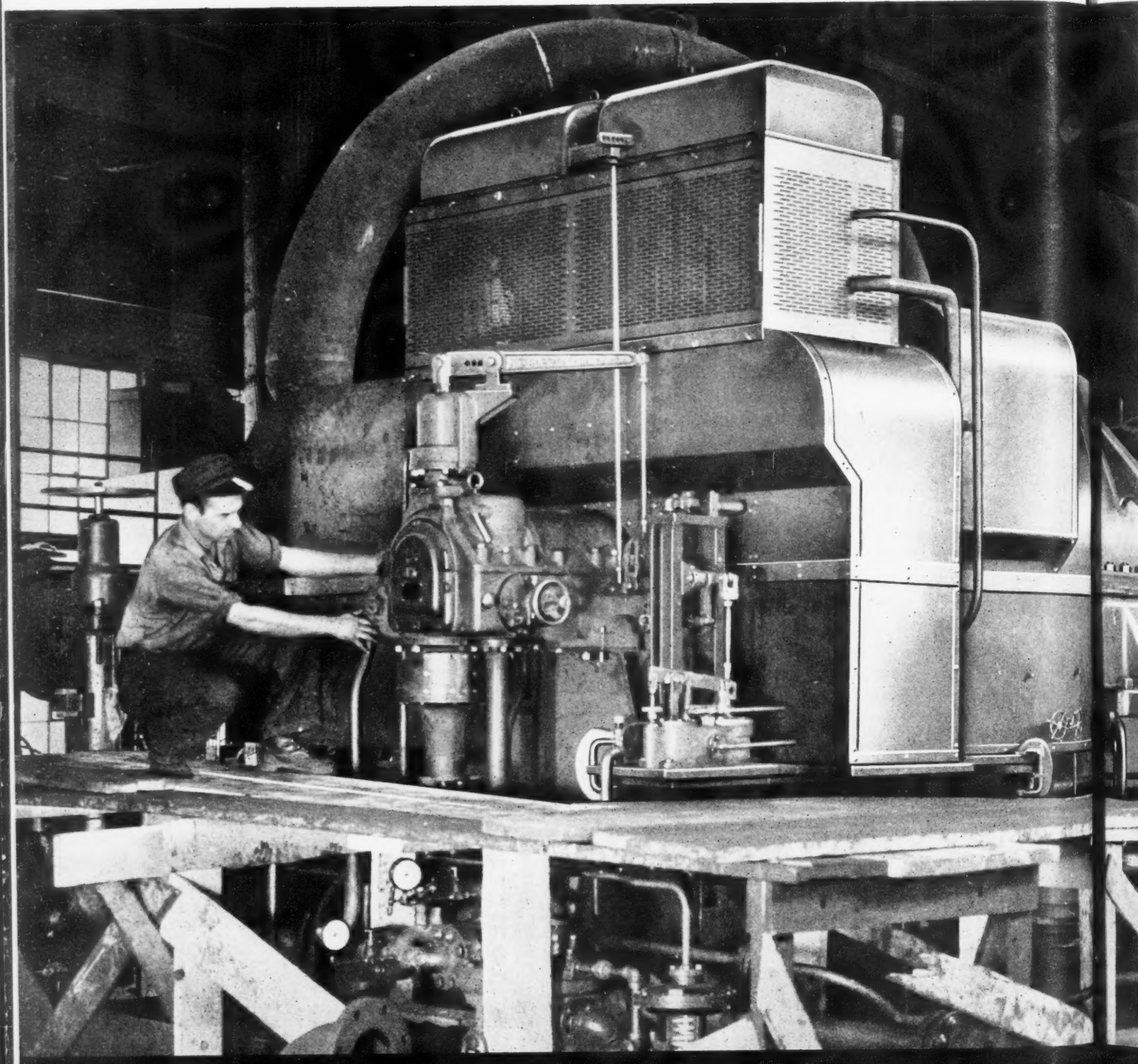


RADIANT BOILER

G-213T

& WILCOX

POWER is the *first* e



ELLIOTT

t essential of VICTORY

HERE, on the test block, is a unit which symbolizes the guns, shells, bombs, tanks, planes and other equipment essential to ultimate victory. Here, about to be "sworn into service" is an Elliott Turbine-Generator, typical of many now helping to provide the driving power to win the war. Typical, also, in its sturdiness and dependability, of the Elliott deaerators, condensers, ejectors, motors, auxiliary drive turbines, and other equipment which are also serving to provide power to turn the wheels that make the things that will bring Victory.

Battles that are won in the field, must first be won on the factory floor, and before that, in the power plant. Elliott Company is proud to be helping to win the Battle of Power.

ELLIOTT COMPANY
Steam Turbine Department
JEANNETTE, PA.
District Offices in Principal Cities

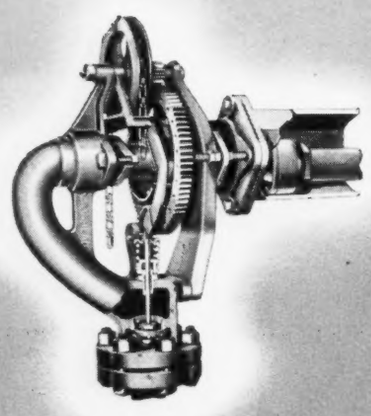
H-656

POWER EQUIPMENT SERVES THE NATION

How TO GET THE MOST OUT OF THE SOOT BLOWERS *you have*

GREATLY increased demand for raw materials that go into soot blowers—similar increase in demand for the finished product—has made soot blower deliveries slower. Our plant, taxed to the utmost by defense requirements, is meeting the needs, but must meet them more slowly.

Hence, with demands for power shooting up—with coal prices trending upward, it is most important that you get the most out of soot blowers you have.



Diamond Soot Blowers require little care—they are built to take it—but it is our experience that they often do not get the little care they need for fullest efficiency. In many cases they are not even oiled.

If you will adopt a regular daily schedule of blowing—and a regular frequent program of inspection, care and oiling of all blowers, you will find it a very worthwhile economy.

It won't take much time, nor much labor. But it will improve the efficiency of your boilers, save fuel, and, which is most important, make your soot blowers last much longer.

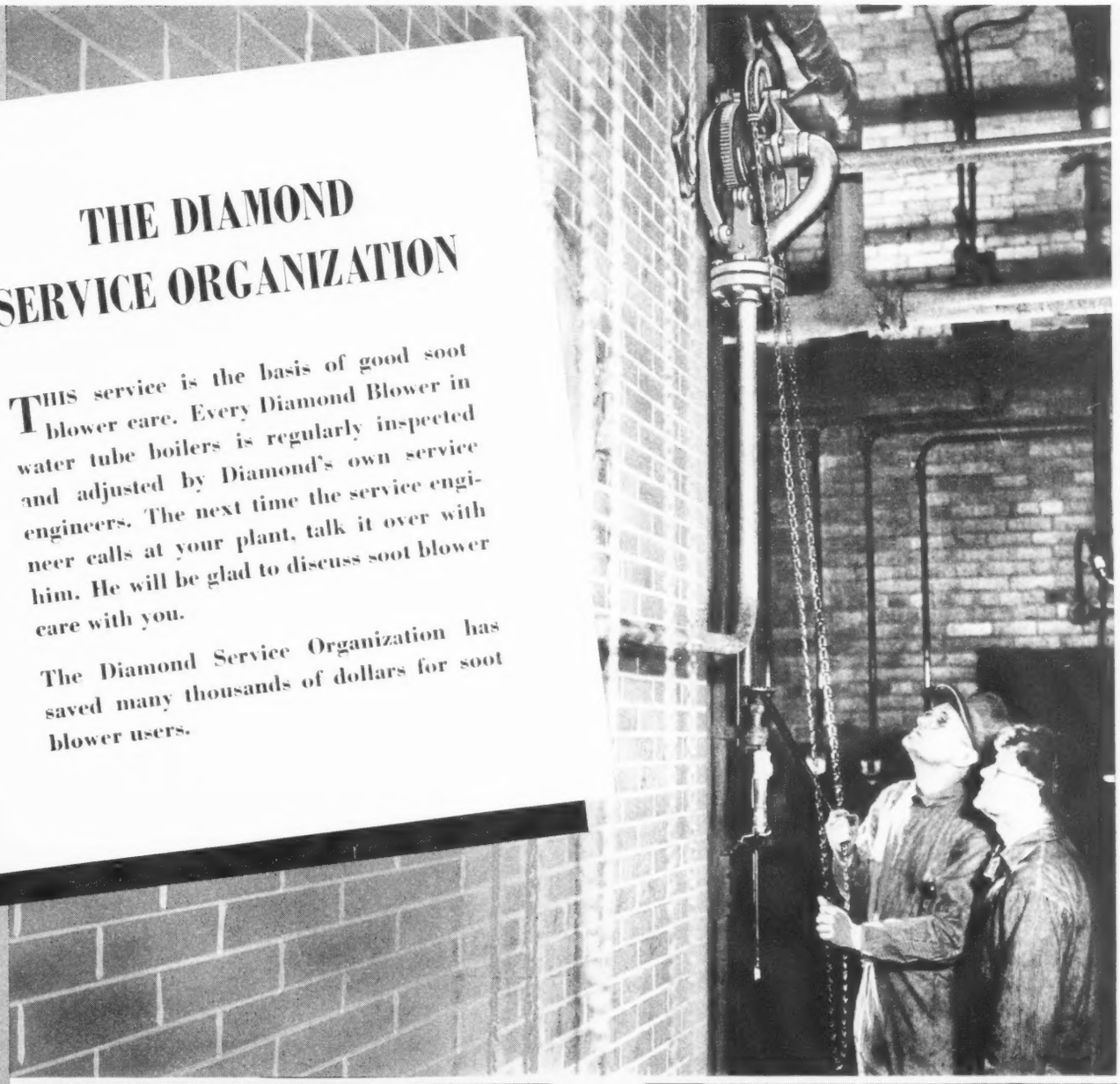
DIAMOND POWER SPECIALTY CORP., Detroit, Michigan

DIAMOND SPECIALTY LIMITED, Windsor, Ontario

THE DIAMOND SERVICE ORGANIZATION

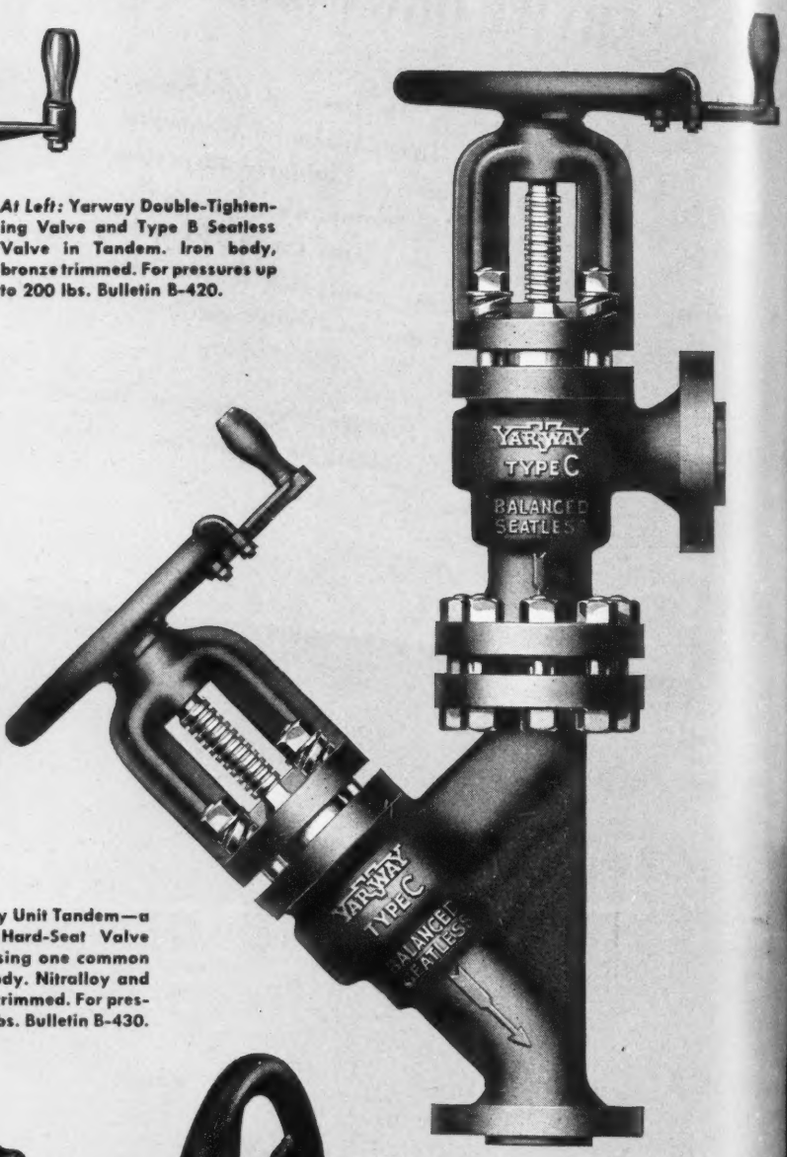
THIS service is the basis of good soot blower care. Every Diamond Blower in water tube boilers is regularly inspected and adjusted by Diamond's own service engineers. The next time the service engineer calls at your plant, talk it over with him. He will be glad to discuss soot blower care with you.

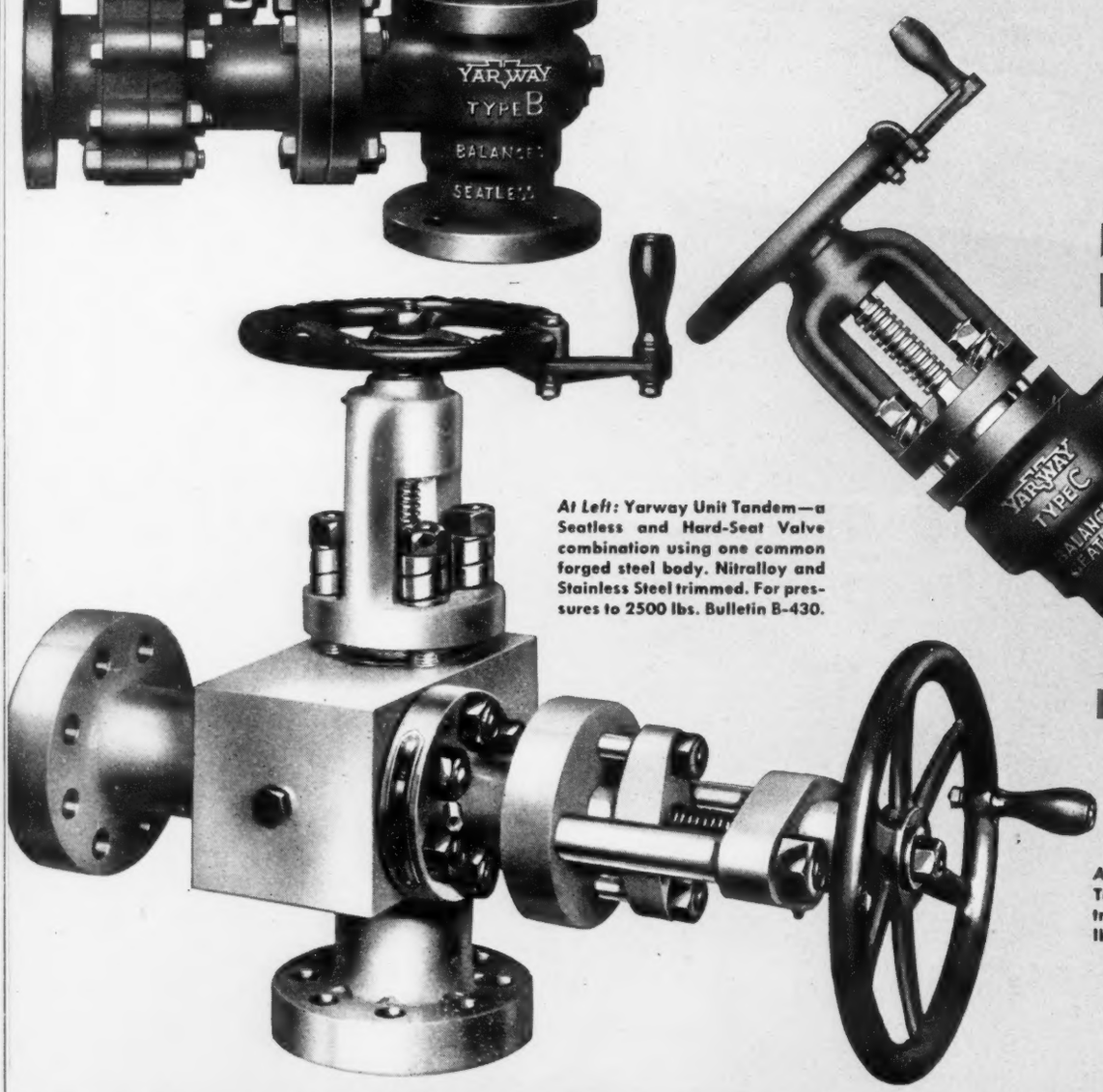
The Diamond Service Organization has saved many thousands of dollars for soot blower users.



Back of Every

At Left: Yarway Double-Tightening Valve and Type B Seatless Valve in Tandem. Iron body, bronze trimmed. For pressures up to 200 lbs. Bulletin B-420.





At Left: Yarway Unit Tandem—a Seatless and Hard-Seat Valve combination using one common forged steel body. Nitralloy and Stainless Steel trimmed. For pressures to 2500 lbs. Bulletin B-430.

Above: Yarway Type C Seatless Tandem. Steel body, Nitralloy trimmed. For pressures to 600 lbs. Bulletin B-430.

YARWAY

YARWAY Product

Sound Engineering Design, Complete Laboratory Tests, Proven Field Performance

THE YARWAY 2500 lb pressure steam laboratory makes possible the testing of every product to the ultimate of service it will be called upon to perform in your plant.

Ample margins of safety are provided not only to meet today's standards but tomorrow's possibilities as well.

Convenience and economy of operation based on sound engineering principles also are provided.

Yarway products are designed for long, trouble-free service—built up to a standard, not down to a price. This is especially important in accessories which become an integral part of major equipment and affect the performance of such primary units.

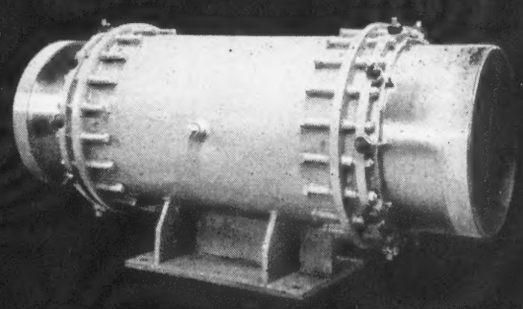
You invest in complete protection when you invest in Yarway-engineered products.

You should have all Yarway catalogs in your library for ready reference—yours for the asking.

YARNALL-WARING COMPANY
100 Mermaid Ave. • Philadelphia, Pa.

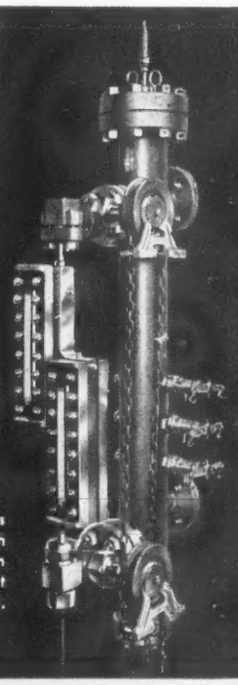
Above: The Yarway Impulse Steam Trap has only one moving part; no buckets, bellows, levers or floats. Bulletin T-1735.

Below: The Yarway Involute Spray Nozzle is non-clogging, trouble-free. No internal parts; contour of body guides flow in an involute path. For cooling condenser water and for air conditioning service. Bulletin N-616.

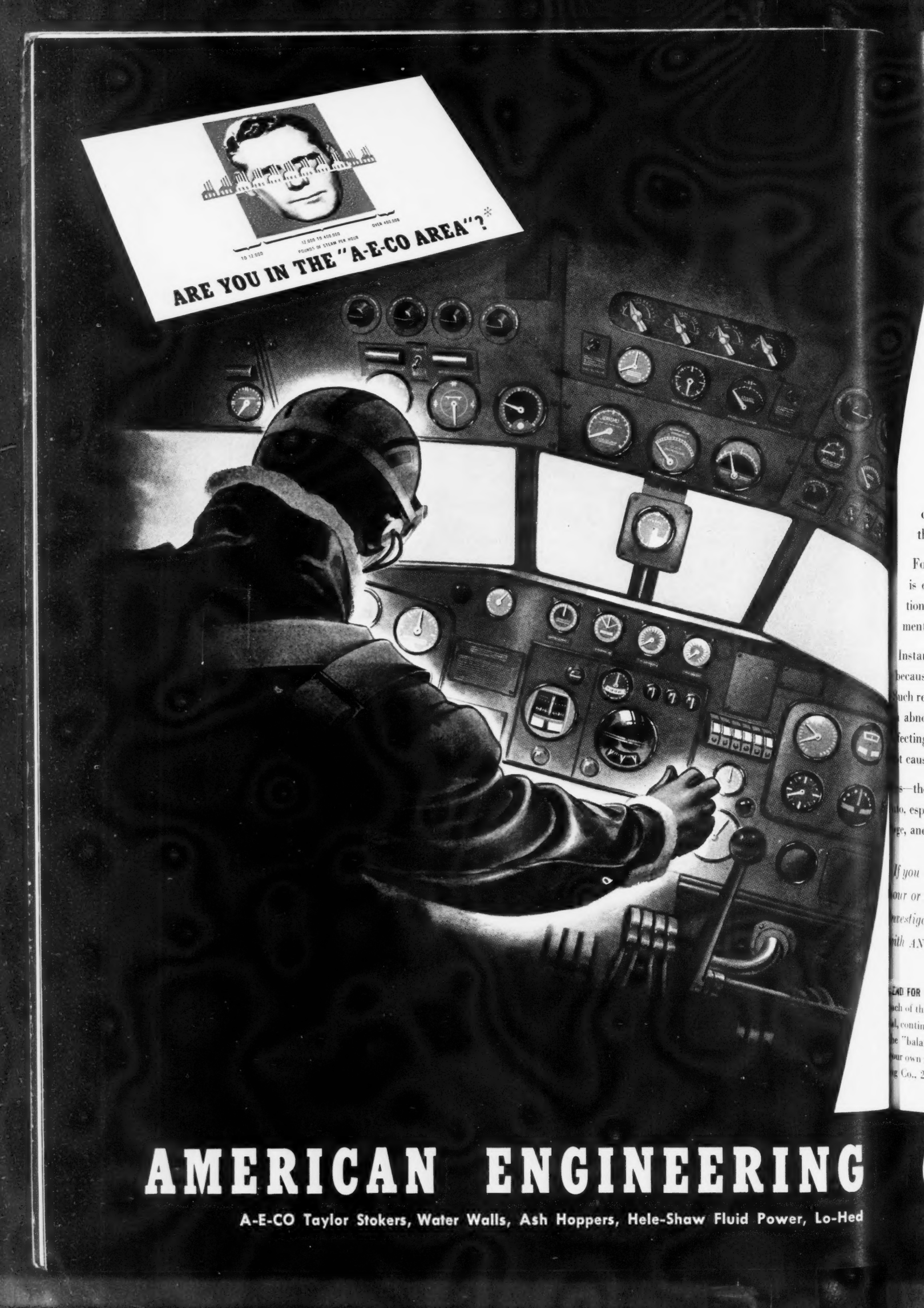


Above: The Yarway Gun-Pakt Expansion Joint may be re-packed under full steam pressure and never needs unpacking. Bulletin EJ-1907.

Right: The Yarway Floatless Water Column operates with balanced solid weights, on the well-known displacement principle. Bulletin WG-1808.



STEAM SPECIALTIES



AMERICAN ENGINEERING

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Hele-Shaw Fluid Power, Lo-Hed

NECESSARY? HERE, YES.
BUT NOT IN YOUR STEAM PLANT

Simplification! *This* is the demand of efficiency in industry. The constant observation of adjustment requirements, and the supervision of unnecessary controls is being eliminated wherever possible.

It is another reason for today's trend to today's Taylor Stoker!

Simplicity of operation with completely adequate controls of basic combustion principles is inherent in the Taylor Stoker. Here they are:

The coal and the fuel bed are easily regulated in each retort by a simplified mechanism at the *front* of the stoker—with secondary pusher control that manages the fuel during the several hours it travels on the grate in the complete combustion process.

For larger units and more exacting load demands, the control system is expanded to provide simple, independent adjustment of small sections of the grate area while the unit is still in service. These adjustments are also made from the front of the stoker.

Instantaneous, precise and frequent control becomes unnecessary—because of the constant and dependable reserve energy on the grate. Such reserve allows wide margin—a margin that even will accommodate abnormal ratio of air and coal for short periods without seriously affecting continuity of service. Momentary failure of coal or air will not cause failure of steaming load.

—the simplified operation of Taylor Stokers is well worth looking into, especially if you are in the A-E-CO Area. Compare this advantage, and all others, with *all* types of fuel firing equipment.

If you operate between 12,000 and 400,000 pounds of steam per hour or more, you are in the A-E-CO Area! You must carefully investigate and compare every advantage of today's Taylor Stoker with ANY other fuel burning equipment!

SEND FOR FREE BULLETINS—giving facts on each of the 12 factors influencing economical, continuous steam generation. Indicates the "balance of power" requirements for your own plant. Write American Engineering Co., 2400 Aramingo Ave., Phila., Pa.

Use These 12 Factors as a "Check Chart" in Demanding FACTS About Any Fuel Firing Equipment

RELIABILITY The Taylor Stoker has a 35 year record of reliability of which 92.7% is typical.

CAPACITY Emergency reserve capacity is readily available over long periods of operation.

MAINTENANCE Average is 3.4c per ton based on a recent study of a typical group of plants.

FLEXIBILITY From 40,000 to 300,000 lbs/hr in 72 seconds. Cold boiler, no fire, to 250% rating in 20 minutes.

EFFICIENCY 16.73c for fuel per thousand pounds of steam is indication of A-E-CO Taylor Stoker "dollar" efficiency.

OPERATION Simplest of any. No complicated adjustments. Coal direct from mine to hopper.

ADAPTABILITY Modernization can be accomplished without seriously disturbing existing plant structure.

FUEL FLEXIBILITY Handles coals of widely varying characteristics; detailed list on request.

REFUSE DISPOSAL Choice of 3 methods; power dump, continuous and rotary.

STACK DISCHARGE 90% average of ash to ash pit. Dust-recovery equipment rarely used—even in heart of city locations.

SPACE REQUIREMENTS Conforms to short and wide, or long and narrow furnaces.

OBSOLESCENSE One basic design used for 35 years enables new improvements to be added to numerous existing installations.

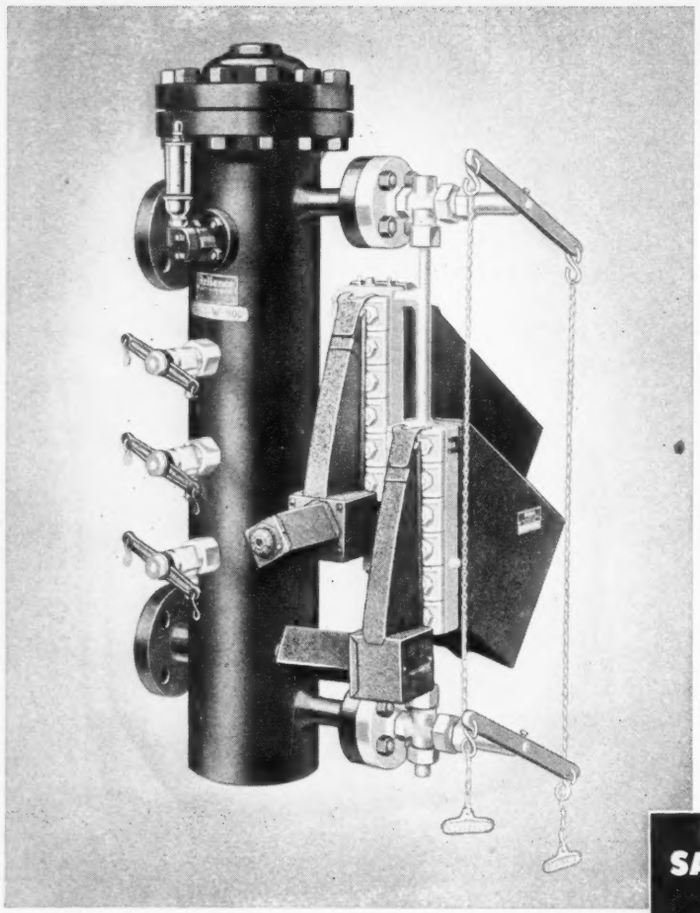
THE A-E-CO Taylor Stoker

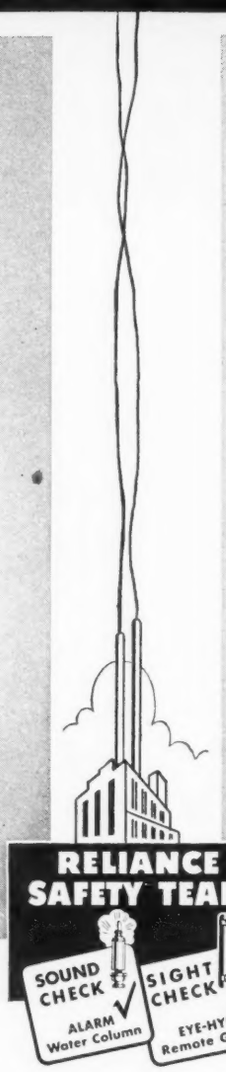
COMPANY

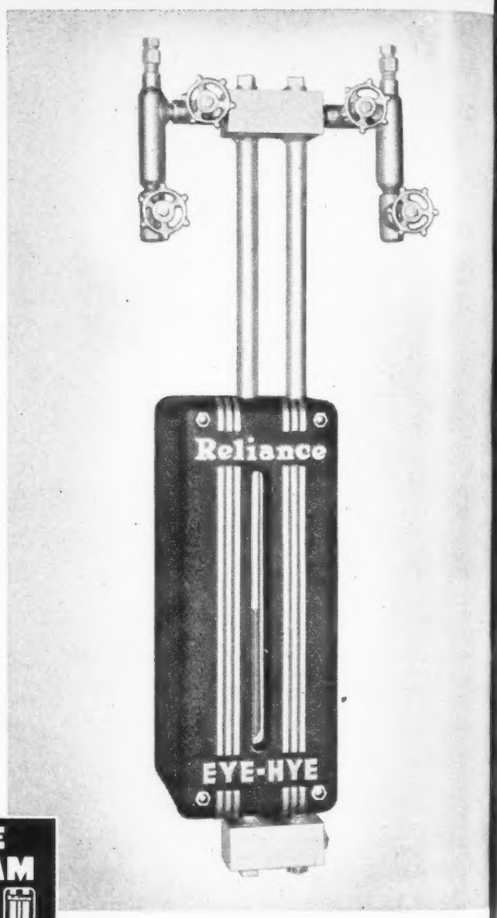
AE CO

Hoists, Marine Deck Auxiliaries

Don't let the power that turns in your plant fail because of







Reliance ALARM Boiler Water Columns

Built and tested at pressures far above your specified working pressure, Reliance high and low water Alarms assure you years of unfailing service under all conditions. Made for pressures from zero to 900 pounds, with equipment engineered and built to match the load. Water columns for all higher pressures available without alarms.

Reliance EYE-HYE Remote Reading Gage

Because EYE-HYE illumination is sharp, clear and highly visible, yet without material light spread, power plants in strategic areas are installing them for water level supervision during blackouts. Easily installed where you want them, regardless of boiler room obstacles.

Since 1884

TRADE MARK REG. IN U. S. PAT. OFF.

Reliance

the wheels of war production
boiler water level accidents!

IF your boilers shut down, priceless time and vital fighting production are lost. *That must not happen!*

But the risk of it is doubled and tripled over ordinary times. With full capacity loads and ceaseless day and night operation, the danger of something going wrong is multiplied. A water level accident now isn't merely embarrassing or costly. It may mean dangerous delay in delivery of needed materiels of war.

Check Your Boiler Equipment Immediately!

Instruments, pumps, feed water regulators, controls of all kinds—including your water level alarms—make sure now that they are functioning perfectly. Maintenance priorities make replacement parts immediately available—order them now—take no chances.

If yours are among the hundreds of thousands of boilers equipped with Reliance water level Alarms, check them at once. We are shipping parts—floats, rods, valves, etc.—promptly.

Now's the Time to Double Your Guard!

In peace time many leading power engineers felt it paid to have the double supervision of Reliance high and low water alarms and EYE-HYE, that shows the exact water level bright green in a gage down on the boiler room floor, where it *has* to be seen. Now Defense has us working all-out producing these safety sentinels for hundreds of power plants on land and sea. We suggest you write for descriptive bulletins.

Yours is a big responsibility—to keep power flowing. Don't take chances . . . check and re-check, now.

THE RELIANCE GAUGE COLUMN COMPANY
5902 CARNEGIE AVENUE • CLEVELAND, OHIO

Contact
Reliance Safety Outposts

If you have a power problem of any kind, phone, wire or write your nearest Reliance Safety Outpost, our field men who are experienced in power engineering problems. They'll be glad to help you.

ATLANTA, GA.
Spotswood R. Parker, 313 Bona Allen Bldg.
BIRMINGHAM, ALA.
Eshelman & Potter, Martin Bldg.
BOSTON, MASS.
Cochrane Steam Specialty Co., 80 Federal St.
BUFFALO, N. Y.
The Stone Co., 295 Hartford Road, Kenmore, N. Y.
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MONTREAL, QUEBEC, CANADA
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The Stone Co., 719 Commerce Bldg.
ST. LOUIS, MO.
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Spurgeon & Smith, Inc., 198 Second St.
SEATTLE, WASHINGTON
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TULSA, OKLA.
L. D. McKay, 533 Mayo Bldg.
WASHINGTON, D. C.
Meleney Engineering Co., 709 Mills Bldg.

BOILER SAFETY DEVICES

1 + 2 + 3

Symmetrical DESIGN

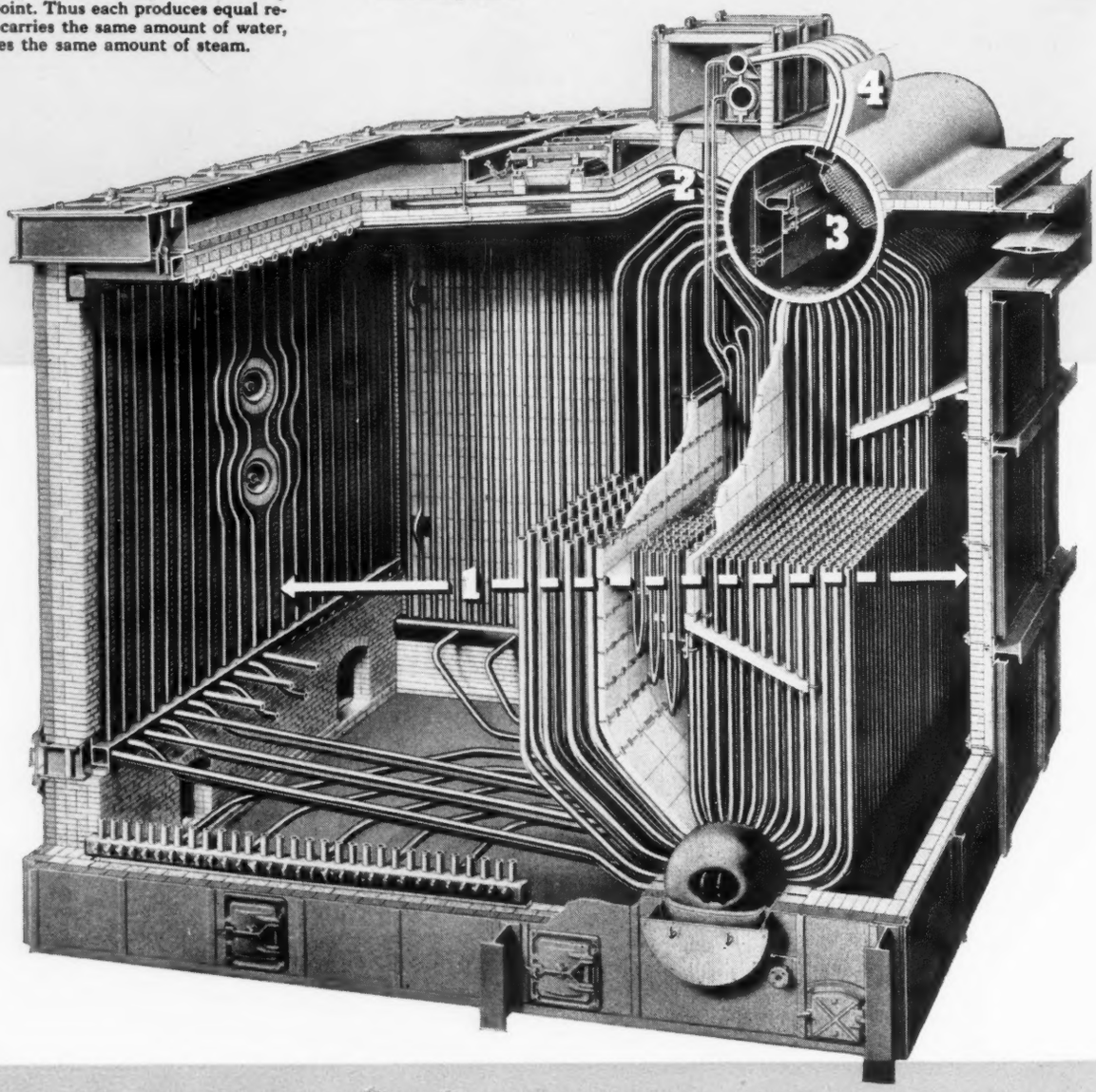
Any longitudinal section taken through the Type VU Generator is the same as any other so taken. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each produces equal results — carries the same amount of water, produces the same amount of steam.

Discharge Above WATER LINE

All tubes comprising the most active steam producing surface enter the steam drum *above the normal water* level; are uniformly distributed across the length of the drum. Turbulence is minimized — steam space is fully and effectively utilized — water level is steady even with fluctuating loads.

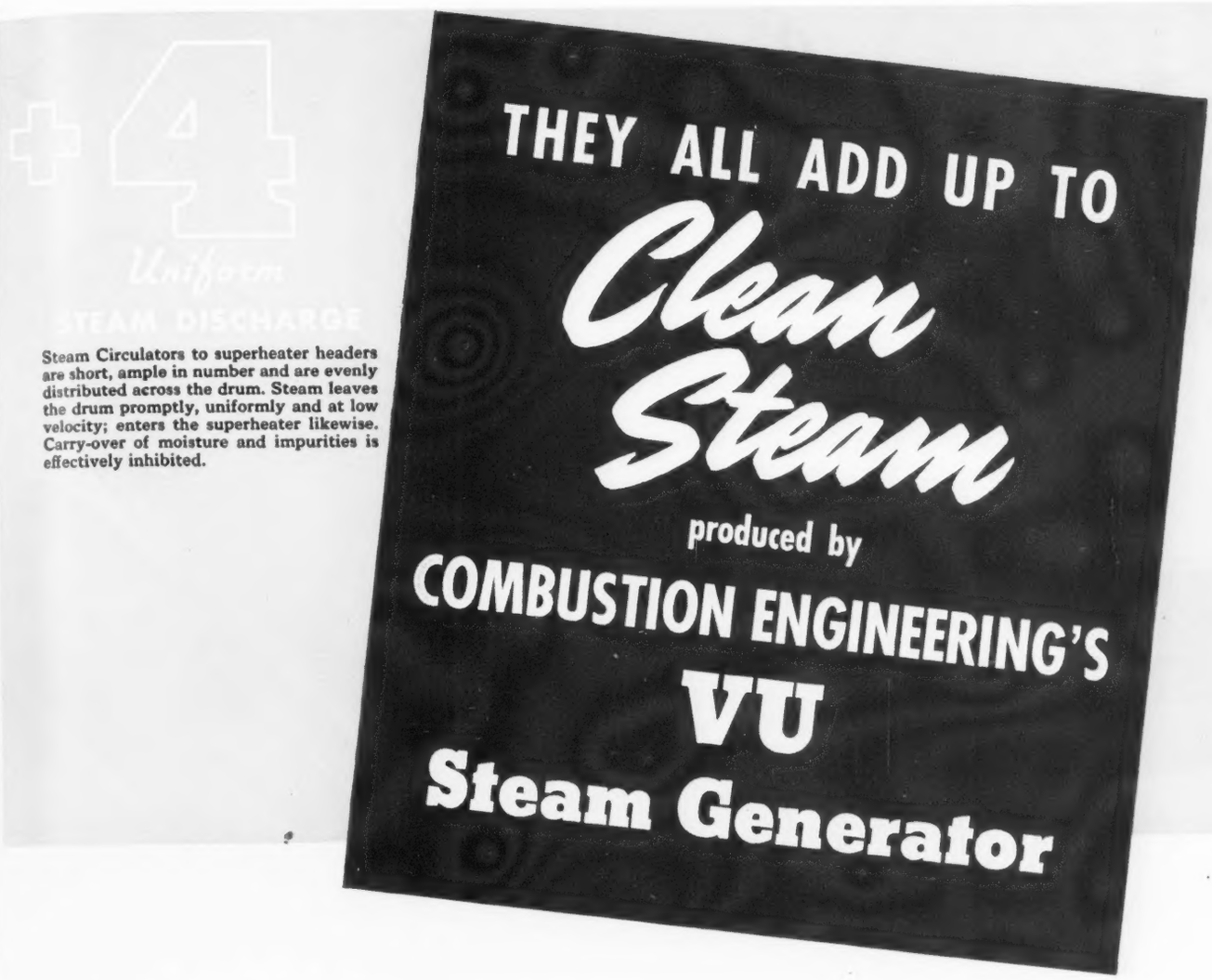
Liberal DRUM VOLUME

A steam drum of liberal diameter is characteristic of VU design. This assures adequate steam space and low steam velocity, thus minimizing the tendency to pick up impurities and permitting maximum opportunity for moisture separation.



C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION


4
Uniform
STEAM DISCHARGE
Steam Circulators to superheater headers are short, ample in number and are evenly distributed across the drum. Steam leaves the drum promptly, uniformly and at low velocity; enters the superheater likewise. Carry-over of moisture and impurities is effectively inhibited.
THEY ALL ADD UP TO
Clean Steam
produced by
COMBUSTION ENGINEERING'S
VU
Steam Generator

As plain as simple arithmetic is the result of these four exclusive features which distinguish the VU Steam Generator. The fact that the steam-water mixture is subjected to uniform gas temperatures across the width of the unit and enters an ample steam space above the water line creates a stabilized condition in the drum free from the surging and spouting which make the process of separating moisture-borne impurities from steam so difficult.

Added together these features provide maximum assurance of clean, dry steam, always important in boiler design and under today's severe operating conditions more important than ever. These features have been thoroughly demonstrated in service by a variety of installations that are meeting requirements from 30,000 to 300,000 lb of steam per hr.

When the advantages of clean dry steam are enhanced by *economical generation*, which is aided by other features of design and construction, you have the reasons for the high percentage of current repeat orders. Received from people who *know* how well the VU Steam Generator operates, they are impressive evidence of demonstrated superiority in design, construction and performance. A599-A

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

Remember
PEARL HARBOR
"Keep 'em Flying"

LUNKENHEIMER VALVES

ARE HELPING TO BUILD BOMBERS

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

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Your Lunkenheimer distributor has a supply. Ask for your copy.

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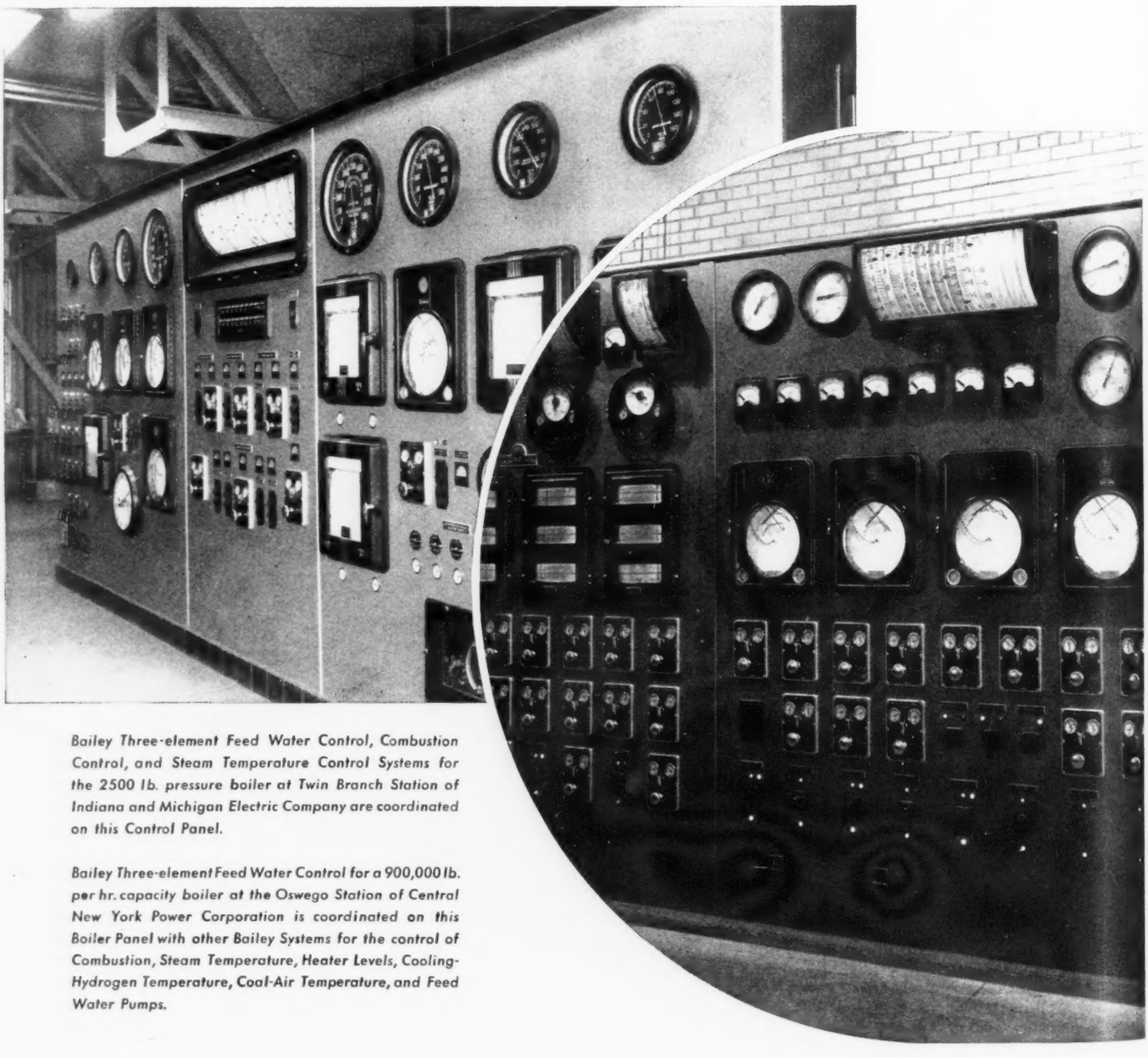
100,000,000 Lb.

Entrusted to Three-



Bailey Three-element Feed Water Control, Combustion Control, and Steam Temperature Control Systems for the 2500 lb. pressure boiler at Twin Branch Station of Indiana and Michigan Electric Company are coordinated on this Control Panel.

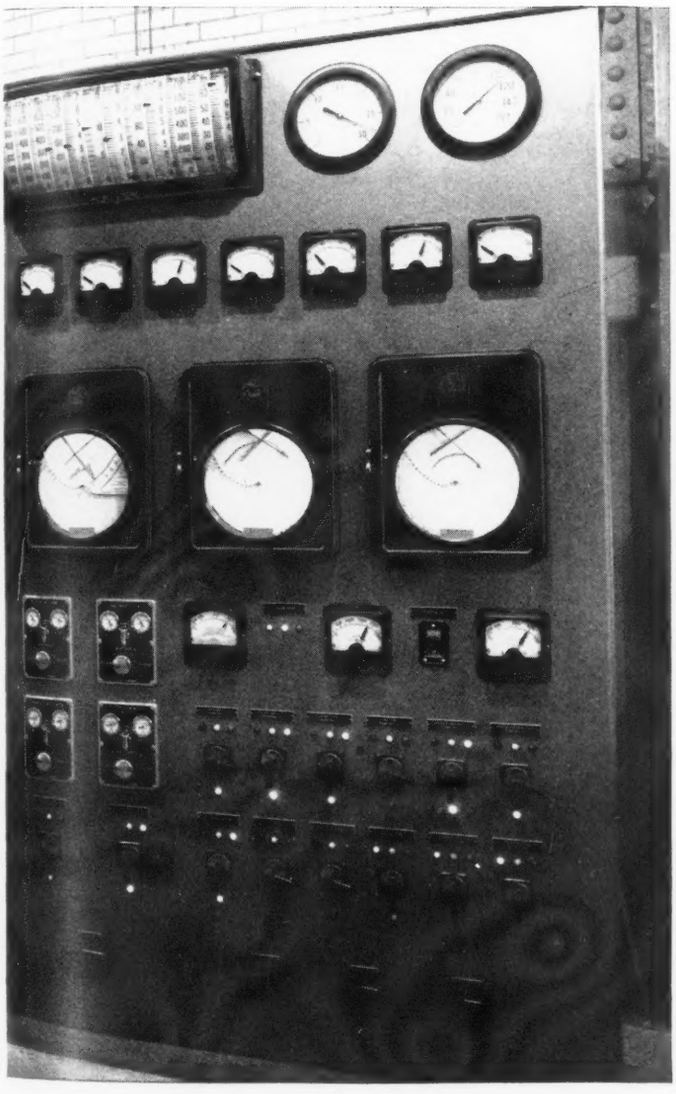
Bailey Three-element Feed Water Control for a 900,000 lb. per hr. capacity boiler at the Oswego Station of Central New York Power Corporation is coordinated on this Boiler Panel with other Bailey Systems for the control of Combustion, Steam Temperature, Heater Levels, Cooling-Hydrogen Temperature, Coal-Air Temperature, and Feed Water Pumps.

BAILEY METER CONTROL • •

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

# of Modern Capacity

element Control



★ One of the most important and exacting control assignments on the modern steam generating unit is that of feed water control. Small water storage, water-cooled furnaces, sensitive economizers, superheat control, and the extreme flexibility of units fired with fuels in suspension all tend to complicate the problem.

Bailey Three-element Feed Water Control was conceived to solve this problem. How well it has succeeded is a matter of record—the safety of over 100,000,000 lb. of modern steam generating capacity is entrusted to its dependable operation. This total is made up of boilers operating at pressures from 150 lb. to 2500 lb. with individual capacities ranging from 50,000 to 1,200,000 lb. per hour.

Bailey Three-element Control is further endorsed by scores of repeat orders from satisfied users. Some of the features which have resulted in this well deserved popularity are:

1. Control of Feed Water is primarily from the rate of Steam Flow.
2. Dependable response at low rates of steaming is obtained by controlling from the actual measurements of standard Bailey Steam Flow, Water Flow, and Water Level Meters.
3. Fast positive control valve action is insured by the use of an outside power source.
4. Metering of feed makes system independent of variations in excess pressure.
5. Speed and accuracy of system maintains level within safe limits even under loss of load or sudden load pick up.
6. System provides for remote manual operation from the boiler panel when desired. Control valve position is always indicated at panel regardless of manual or automatic operation.
7. Complete records of performance are made by the Steam Flow, Feed Water Flow and Water Level Meters used with the system.

If you do not already have information on this fast, dependable system of feed water control, ask for your copy of bulletin No. 105 now.

A-81

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND, OHIO

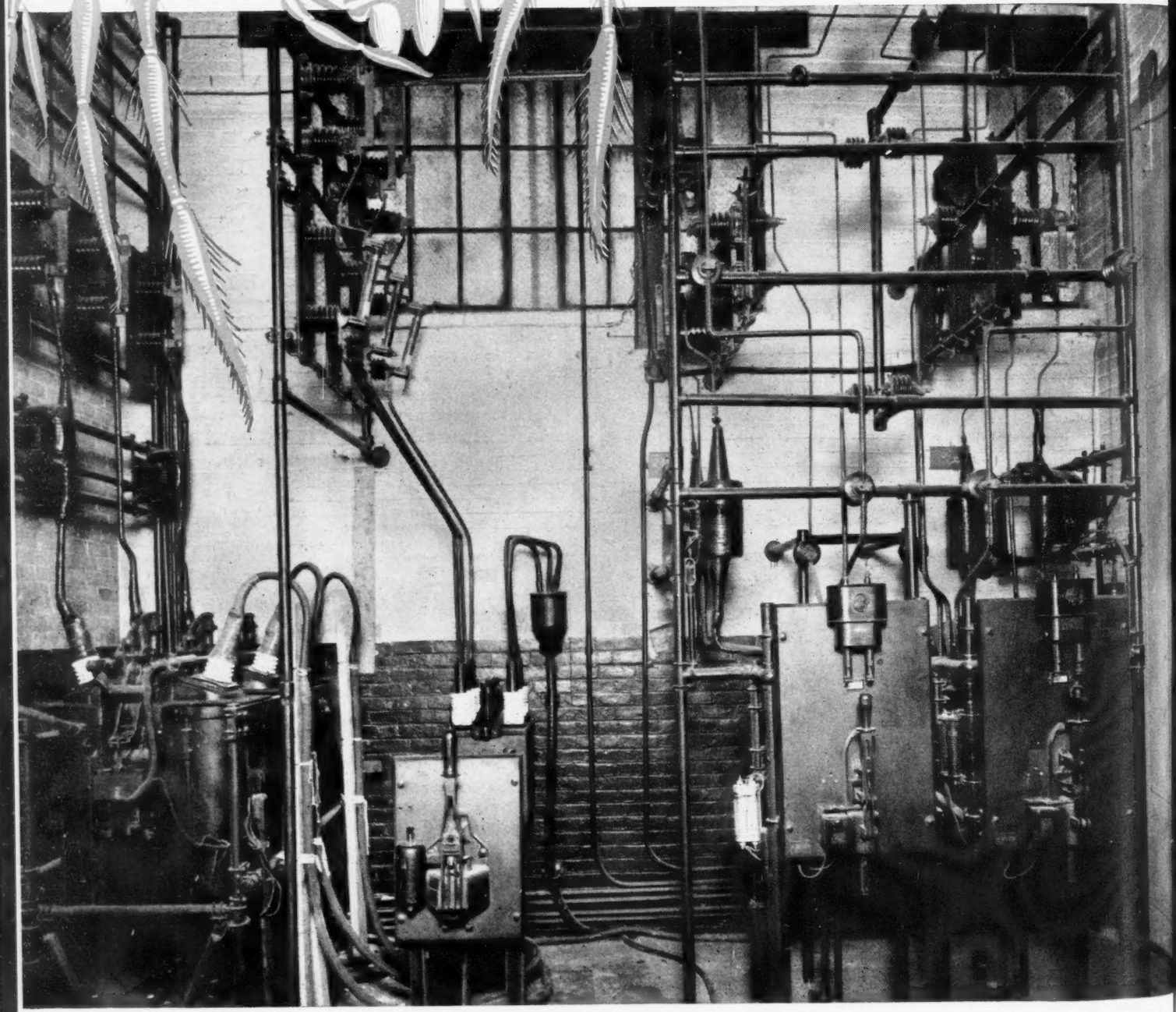
Bailey Meter Company Limited, Montreal, Canada

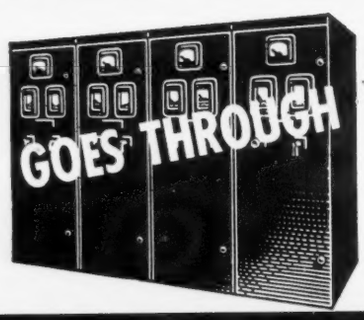
. . . . The Complete Boiler Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

"SPIDERWEB SWITCHGEAR"

will tangle up your production!





ALL YOUR POWER YOUR SWITCHGEAR

Here's the METAL-CLAD ANSWER

Completely Enclosed in Grounded Metal—to Protect Your Personnel and Safeguard Continuous Production

You Get All This:-

COMPLETE CO-ORDINATION of switchgear devices. All the devices are designed to operate as a unit.

LOW PREDICTABLE INSTALLATION TIME—AND COST. The equipment is *complete* and ready to install as a unit.

SAFETY. All conducting parts are amply insulated, and located behind grounded walls of metal. Every part is made to withstand short-circuit stresses equal to the rating of the breaker.

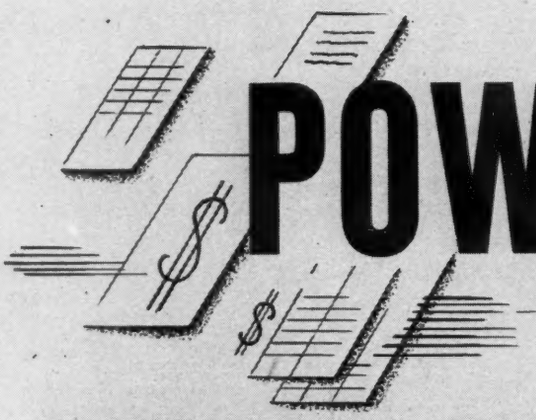
EASY, SAFE INSPECTION. The breakers are easily removable, and can be withdrawn and replaced in a few minutes. You can inspect them away from all live parts.

Write for Bulletins GEA-2499 and GEA-3083 (up to 15 kv) and GEA-2249 (up to 5 kv). General Electric Company, Schenectady, N. Y.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance

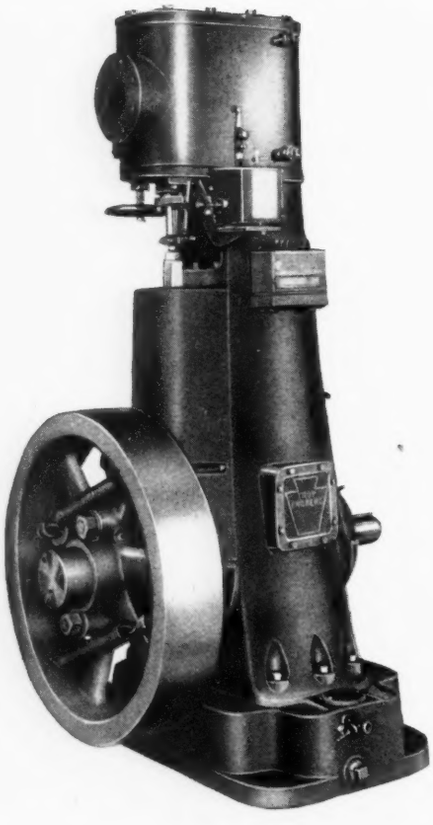
GENERAL ELECTRIC

354-15-7B



POWER COST..

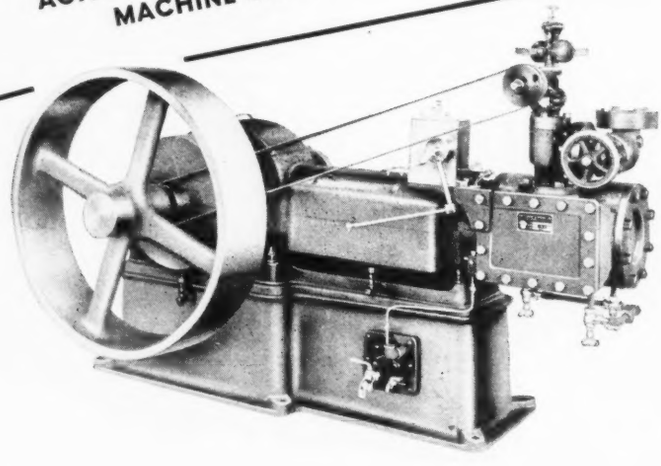
MEASURES THE "UP-TO-DATENESS"



TROY-ENGBERG STEAM ENGINES

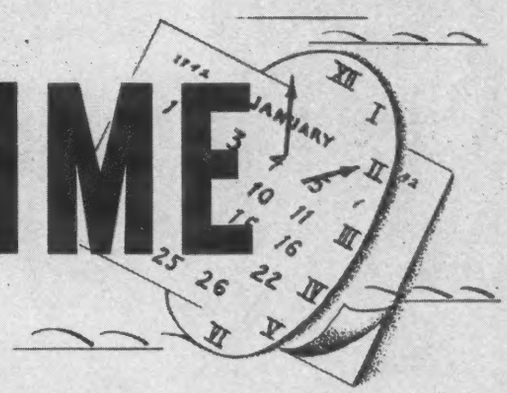
are widely used for driving such equipment as

FANS
BLOWERS
COOKERS
COMPRESSORS
EXHAUSTERS
AGITATORS
PUMPS
STOKERS
DRYERS
GENERATORS
CORE DRILLS
NITRATORS
MACHINE SHOP EQUIPMENT



TROY-

rather than TIME



OF THE EQUIPMENT DRIVE

A HALF cent per kw.h. over-all power cost is as modern as anything . . . and it's the power cost and drive characteristics which determine whether or not a drive is modern!

Hundreds of Troy-Engberg Steam Engines are operating at around ½ cent per kw.h. for *all* costs; some higher, some lower. They are driving all sorts of equipment both in the power plant proper and out in the factory hooked up to production equipment. Such low power cost certainly stamps the drive as being modern.

As for drive characteristics, today's steam engines have that flexibility under automatic control which is so desirable; their utter dependability and absence of fire hazard make them the choice for many oil refinery charging pumps; their wide speed range makes them ideal for much production equipment; their conservative speed permits direct connection in many cases.

Yes, the steam engine as designed and built today by Troy-Engberg is modern in every sense of the word and offers very desirable drive characteristics.

TROY ENGINE AND MACHINE CO.

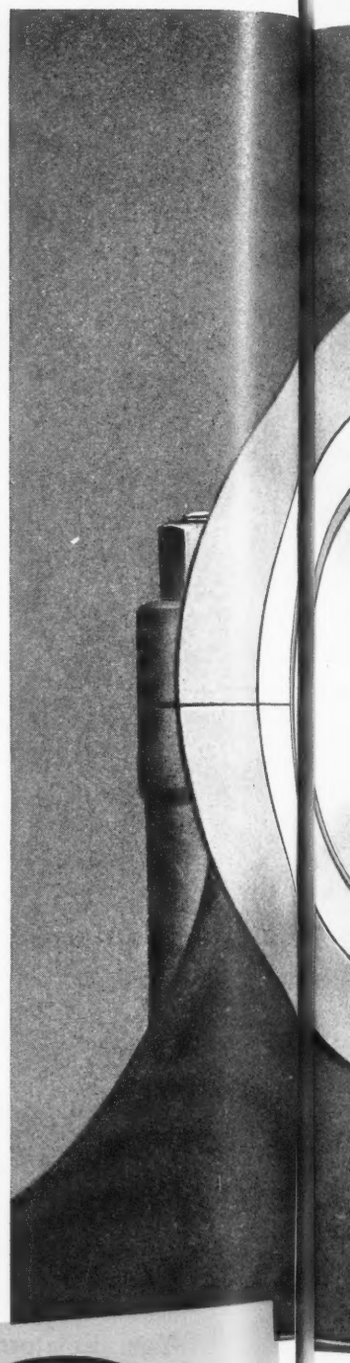
Established 1870

1477 Railroad Ave., Troy, Pa.

2 TEM 1

ENGBERG STEAM ENGINES • • • GENERATING SETS

Keeping a High-Speed Journal "Afloat"...



THE "CORRECT" ANSWER TO AN ESSENTIAL PROBLEM IN DEFENSE POWER PRODUCTION:

Problem: To the naked eye, a steam turbine bearing presents highly polished surfaces. But under a microscope, as you see at the right, these surfaces appear as jagged hills and deep valleys. Clearances between journal and bearing are very close. And as the journal turns, the irregularities tend to interlock and cause friction. If such contact is allowed, bearing surfaces will be quickly destroyed.

Answer: The bearing must be flooded with oil by a circulation system. Rotation of the journal then builds up a hydraulic pressure which, in turn, produces an oil "wedge" thick enough to actually float the bearing.

But just "any" oil won't do here. That's important to remember. Speed, pressure, and heat are severe. And the oil is used over and over again — sometimes for many years — under these conditions.

Gargoyle D. T. E. Oils are made to resist heat and pressure ... to give years of dependable service in steam turbines.

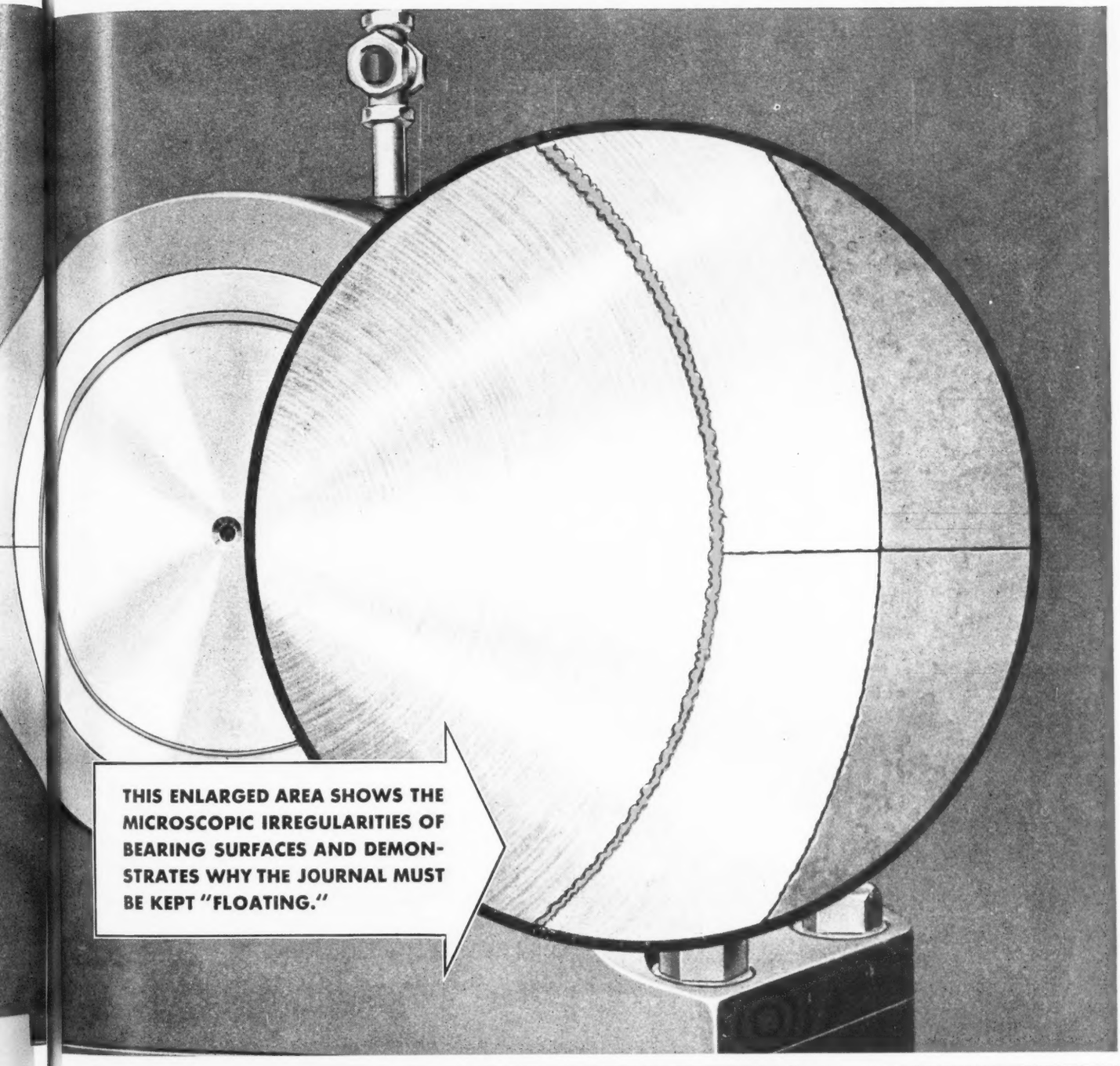
TO HELP MAINTAIN CAPACITY PRODUCTION, CALL IN

SOCONY-VACUUM for "Correct Lubrication"

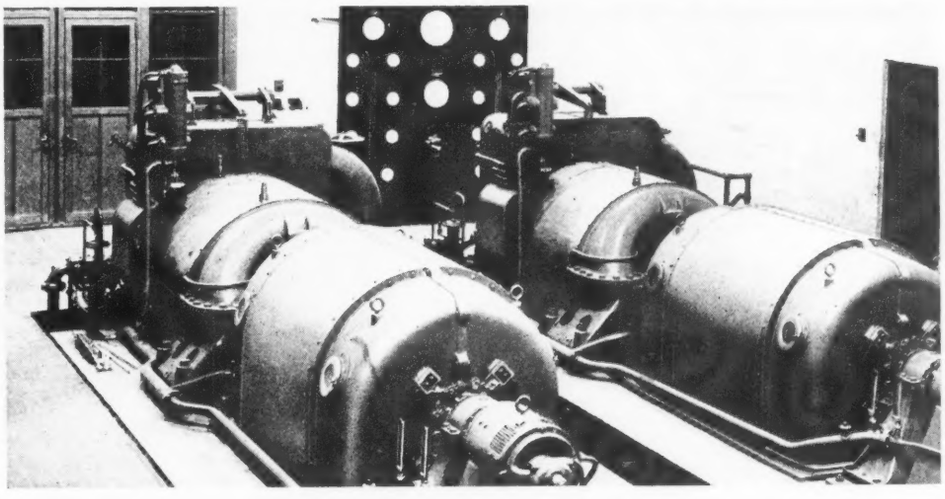
SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div. Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div. (Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.

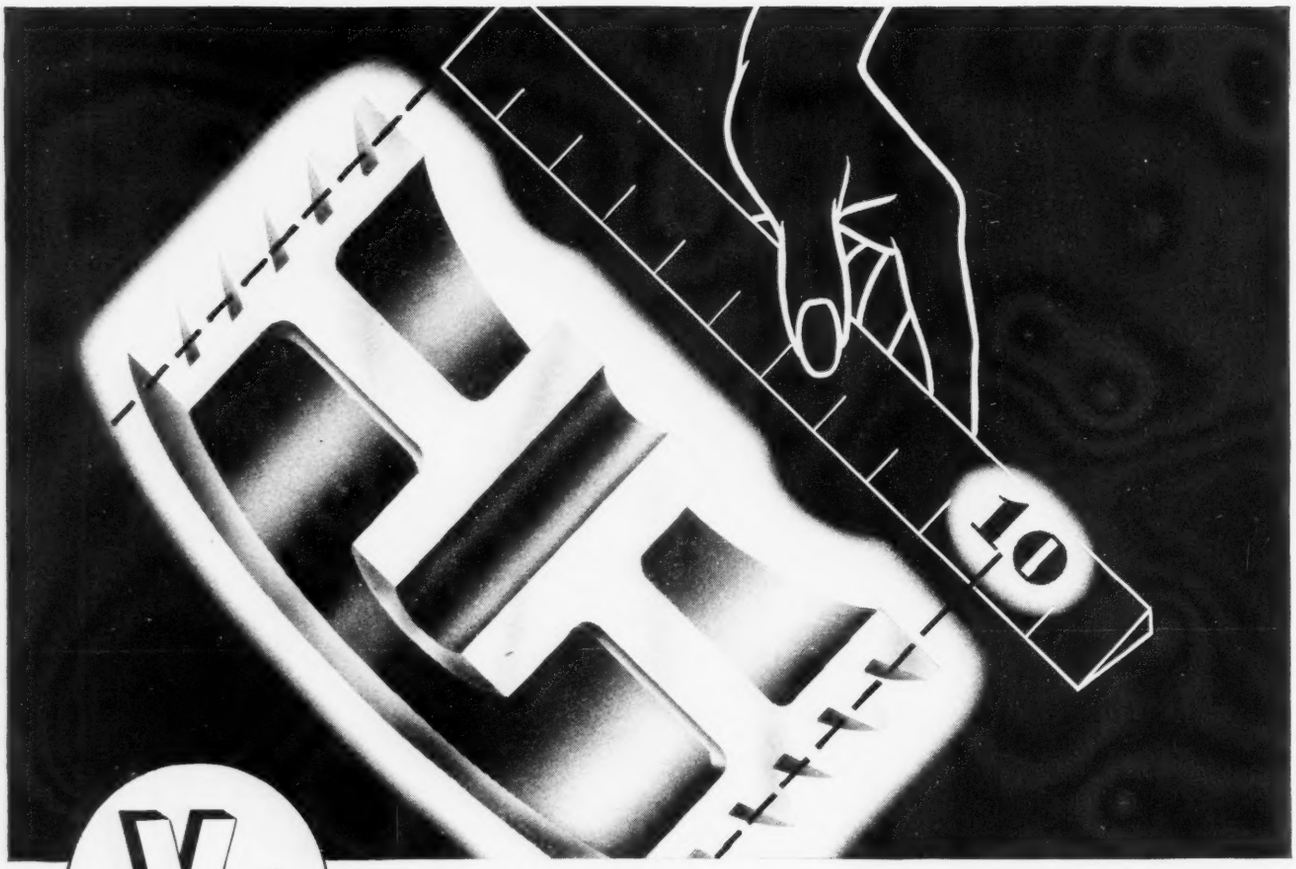
GARGOYLE

Lubricants


THIS ENLARGED AREA SHOWS THE MICROSCOPIC IRREGULARITIES OF BEARING SURFACES AND DEMONSTRATES WHY THE JOURNAL MUST BE KEPT "FLOATING."

BECAUSE of their stability and fine resistance to oxidation and deposit formation, Gargoyle D. T. E.'s are lubricating more than 50% of the U. S. A.'s major-sized steam turbines—a record unequalled by any other brand.





MULTIPLE V-BELT DRIVE ASS'N

THE DOMINANT DRIVE OF INDUSTRY

TRADE MARK

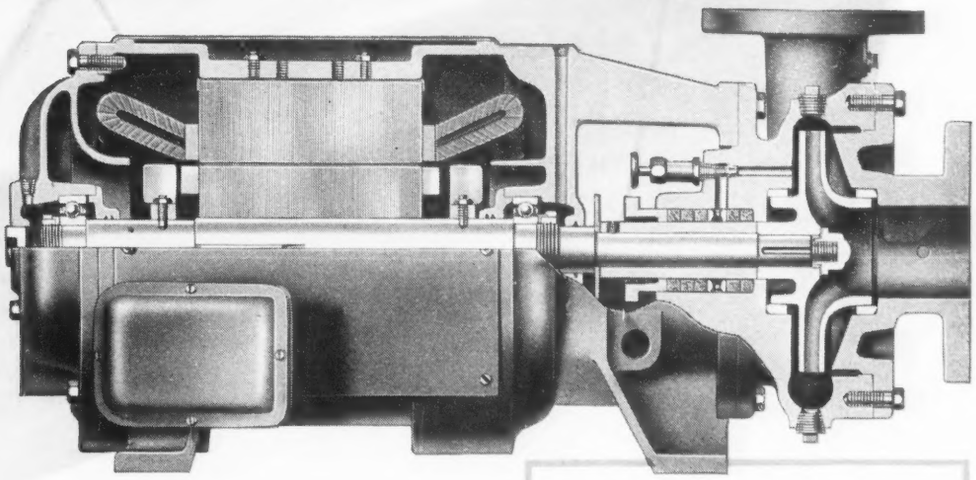
The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence — the result of cooperative engineering, research and experience.

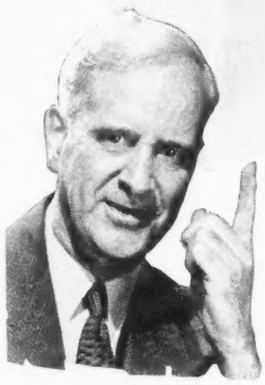
engineering standardizes —industry economizes . . .

Along with the recognition of the superiority of the Multiple V-Belt Drive, there arose a serious problem which threatened to offset the advantages of the new, highly efficient method of power transmission. . . . Because speed ratios between driver and driven members did not permit of variation, the necessity for at least one sheave in a drive to be made to special dimensions was frequent. Not only was this costly, but usually it entailed delay. Moreover, the procedure was repeated when replacement became necessary. . . . Association members were quick to realize the need for eliminating this condition. Engineering committees were put to work to develop standard sheave and belt sizes which would make "specials" the exception, instead of the rule. Today, approximately 600 different speed ratios and over 25,000 sheave combinations are made available from standard sizes. . . . Again, the value of pooled information and cooperative effort by association members, with resulting huge savings to industry, was demonstrated.

MULTIPLE-V-BELT DRIVE ASSOCIATION
140 SOUTH DEARBORN STREET • CHICAGO

ALL WRAPPED UP FOR SERVICE!





One-Package Design With One-Package Convenience And Efficiency! That's How Allis-Chalmers New Electrifugal Pump With Exclusive "Tri-Fit" Construction Saves Space—Saves Wear—Cuts Your Costs!

EASIER TO INSTALL — easier to service — more trouble-free pumping power . . . that's why every industry is finding a place for this wonder pump!

Unified "Tri-Fit" construction guarantees more positive alignment of the single shaft, less wear and tear . . . smoother running, vibration-free operation.

A new motor . . . 100% designed for pump drive and completely splash-proof . . . gives far more efficient power.

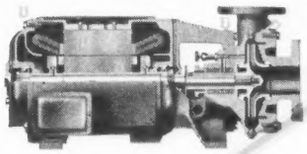
One-piece frame saves as much as 33% in space . . . 40% in overhang! Indestructible rotor and distortionless stator provide low maintenance and trouble-free operation. Cast bronze protective sleeves, splash-proof ventilation and cast aluminum fans are other features that make this revolutionary pump a great achievement in design and construction!

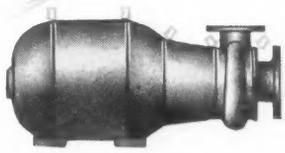
Best of all . . . *it cuts your costs up to 33% over conventional pump installations.*

There's a full line from ½ HP to 25 HP . . . the price is right . . . and there's no waiting for deliveries. Call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis., for Bulletin B-6140.

A-1460

MAKE THIS 3 TO 5 TEST YOURSELF





The NEW Allis-Chalmers Electrifugal Pump has only three section-fits compared to five or more for old style pumps! That means more perfect alignment of the shaft . . . less vibration . . . less wear . . . less trouble. Here's a pump that gives you more gallons . . . for less cost!

Allis-Chalmers Pumps Can Cut Your Pumping Costs

ALLIS-CHALMERS
MILWAUKEE-WISCONSIN

8 Corrosion-resistant metals that offer you

STRENGTH PLUS...

The plus properties of these 8 INCO Nickel Alloys meet a wide variety of fabrication and service requirements...

Strength combined with corrosion resistance, as you know, have long been associated with Monel. But sometimes you need extra hardness, heat resistance, resilience, or some additional property. These and other *plus* characteristics are offered by other INCO Nickel Alloys. Find out more about this useful family of metals. Write for the new booklet, "Individualized INCO Nickel Alloys."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N.Y.

plus **CORROSION RESISTANCE** . . . together with strength, hardness, toughness —	**MONEL**
plus **EXTRA HARDNESS** . . . comparable to heat-treated alloy steel; heat-treatable, non-magnetic —	**"K" MONEL**
plus **HEAT RESISTANCE** . . . with retention of high degree of strength. Resists oxidation, high corrosion resistance —	**INCONEL**
plus **MACHINABILITY and EXTRA HARDNESS** . . . free cutting, heat-treatable, non-magnetic —	**"KR" MONEL**
plus **RESILIENCE** . . . heat-treatable, for exceptional spring properties, magnetic, good electrical conductivity —	**"Z" NICKEL**
plus **MACHINABILITY** . . . for high speed production in automatic screw machines —	**"R" MONEL**
plus **HARDNESS in CASTINGS** . . . anti-seizing and non-galling —	**"S" MONEL**
plus **NON-CONTAMINATION** . . . protects product purity; offers good electrical conductivity —	**NICKEL**

★ FIRST THINGS FIRST ★

With the Nation at war, supplies of Monel, Nickel and Nickel Alloys are needed for our armed forces. Although all efforts must now be aimed toward victory, The International Nickel Company will continue to report developments for the information of metal users who are concerned with the war efforts of today and the peace-time progress of the future.

SOME TYPICAL MECHANICAL PROPERTIES

INCO ALLOY	*CONDITION*	*Tensile Strength 1000 psi.*	*Yield Strength 0.2% Offset 1000 psi.*	*Elongation in 2 in. per cent*	*Hardness Brinell 3000 kg.*	*Toughness Standard Izod-ft.-lbs.*
MONEL	Cold-drawn, as drawn	85-125	60-120	35-15	160-250	115-75
"K" MONEL	Cold-drawn, heat-treated	140-170	100-130	30-15	260-320	26*
INCONEL	Cold-drawn, as drawn	95-150	70-125	30-15	180-290	100-70
"KR" MONEL	Cold-drawn, heat-treated	140-170	100-130	30-15	260-320	..
"Z" NICKEL	Cold-drawn, heat-treated	160-190	120-150	20-7	300-380	25
"R" MONEL	Cold-drawn, as drawn	80-115	50-100	35-15	150-230	99
"S" MONEL	Castings as cast	110-145	80-115	4-1	275-350	9-3
NICKEL	Cold-drawn, as drawn	65-115	40-90	35-15	125-230	120

**Specimen completely fractured.*

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

HIT NEW PRODUCTION PEAKS!

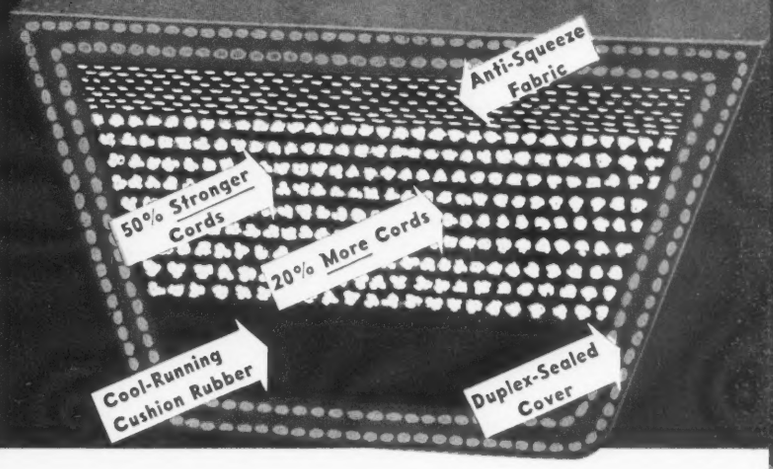
WITH NEW TEXROPE* SUPER-7

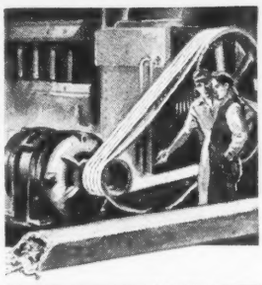
1 50% STRONGER CORDS! Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.

2 20% MORE CORDS! Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.

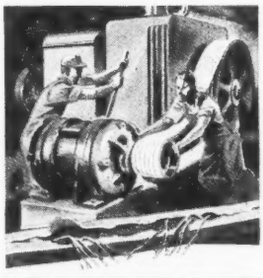
3 INCREASED LIFE! Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.

4 EXTRA PROTECTION! Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

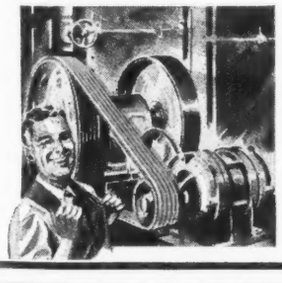




LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong... but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.



WARNING SIGN! Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.



SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch... great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.

TO WIN the war—America needs top efficiency in the use of its power...

That's why Texrope Super-7 V-belts have a double-barreled value today. For here's a line of V-belts that has been designed and built to give you increased pulling strength and drive efficiency...plus longer belt life under the toughest war-time operating conditions.

In every way these belts are better—

You'll find they have 50% stronger cords! 20% more cords! A new rubber cushion section that effectively absorbs shock! Full protection against heat, dirt, moisture, and other adverse factors that quickly shorten the lives of ordinary belts.

You'll find, too, they give smooth, silent, slipless, high efficiency performance—in "matched" sets, and in sizes and types to meet your every requirement.

Whatever your war-rushed power transmission needs, don't be satisfied with anything but the best—*and that best is Allis-Chalmers Texrope Super-7—the V-belt for Victory!*

Call your Texrope dealer or the Allis-Chalmers district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin.

Available in All Sizes
½ hp to 2000 hp

A1473

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

*Trade mark registered U. S. Patent Office. Texrope Super-7 Belts are the result of the co-operative research and design genius of *two* great companies —Allis-Chalmers and B. F. Goodrich—and are sold exclusively by Allis-Chalmers.

Power Plant Capacity Must be Maintained! Why Take a Chance on Unplanned Outages? Read About the Allis-Chalmers Feedwater Treatment Service . . . and How it Protects Your Plant!

HOW TO GET more capacity out of your power plant, without any new additional equipment to do it with — that's the big problem today!

It means stepping up efficiencies to a new high. It means using reserve and stand-by equipment. It means keeping all units going *all the time*... with scheduled outages farther apart and *unscheduled outages entirely eliminated!*

That's where the Allis-Chalmers Feedwater Treatment Service comes into the picture. For here's a service that's based on one fundamental fact —

Boilers and prime movers *must* be protected against scale, corrosion, carryover, embrittlement, and other feedwater troubles if continued service is to be expected. And the best way to do it is to analyze each plant's problems individually and give that plant the specific treatment it needs.

That's the idea behind the Allis-Chalmers Feedwater Treatment Service . . . based on Allis-Chalmers' 60 years experience in manufacturing power plant equipment, plus 15 years experience in providing feedwater service to industry.

Why take chances? Get the facts, today, by writing Feedwater Division, Allis-Chalmers, Milwaukee . . . for a copy of Bulletin B6133.

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

A 1450

How Chromium Steels

help to maintain uninterrupted power plant operation

CHROMIUM steels have high strength at elevated temperatures and are highly resistant to corrosion and oxidation. Because of this combination of properties, the use of chromium steels in power plant equipment keeps costly and time-consuming shutdowns for repair and replacement at a minimum and makes for fast, uninterrupted, economical operation.

Steels containing 4 to 6 per cent chromium are being used for superheater tubes in high-temperature steam installations. Chromium-nickel stainless steel of the 18-8 type is being used for piping, spacer castings, pump shafts, turbine blades, and other equipment parts subject to corrosion and erosion. The higher chromium steels have maximum resistance to oxidation, and are used for equipment parts subject to extremely high temperatures. The illustrations may suggest how you can use chromium steels to maintain uninterrupted operation—vitally important for National Defense.

We do not make steel of any kind, but we have for over 35 years produced "Electromet" ferro-alloys used in making steel. With the knowledge accumulated from this experience, we are in a position to give you, without obligation, impartial assistance in the selection of a chromium steel to suit your particular needs.

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

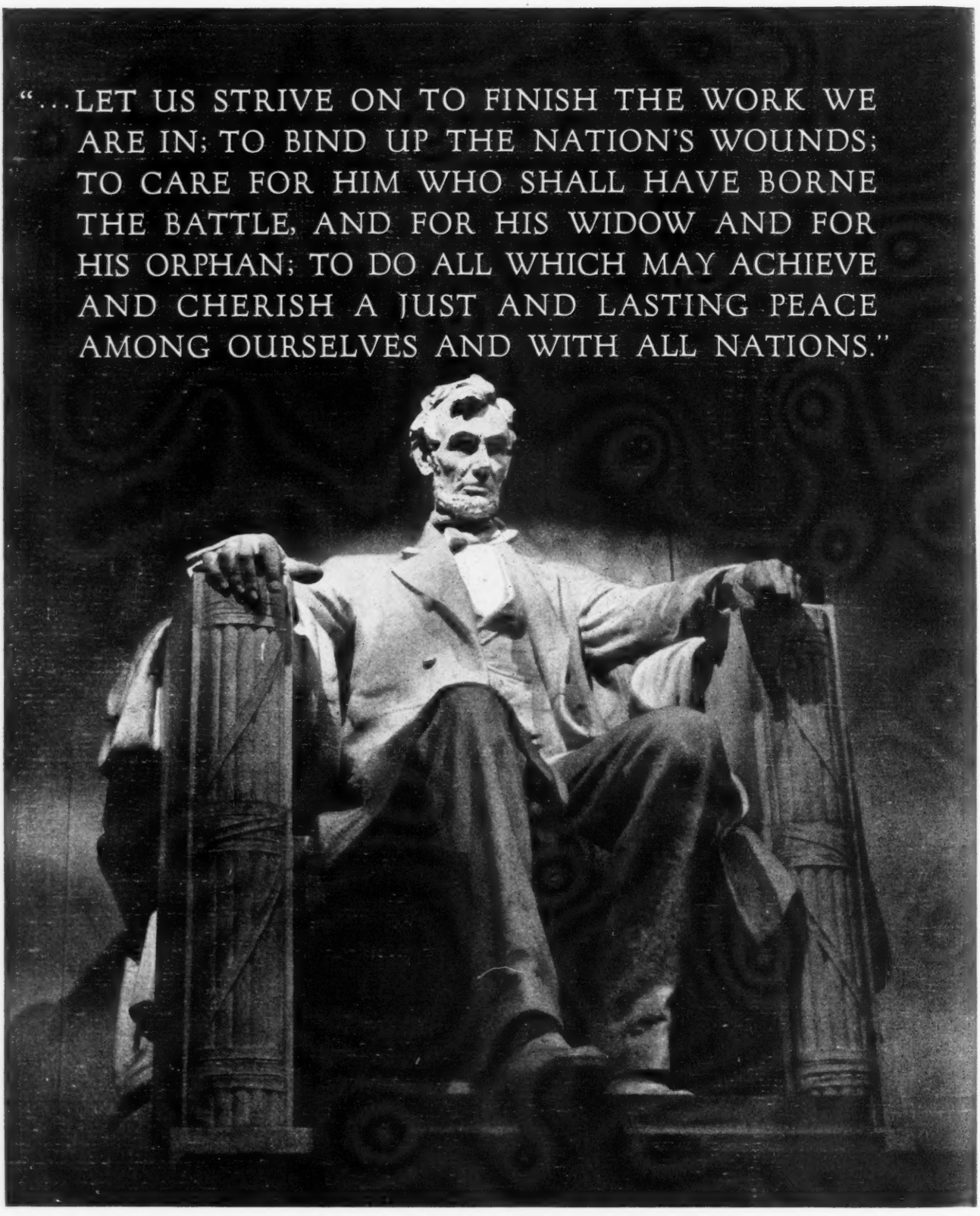
30 East 42nd Street UCC New York, N. Y.

In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Stainless steel was used for the blades of this new 1000-kilowatt, wind-driven turbine because of its high strength, corrosion resistance, and adaptability to spot welding. These same properties make stainless steel useful in steam turbines and other power plant equipment where corrosion and wear would quickly cause ordinary steel to fail.

Stainless steel rapper plungers solved troublesome problems of corrosion and abrasion in the dust-precipitating system of this Government Central Heating Plant.

Electromet
Trade-Mark
Ferro-Alloys & Metals


"...LET US STRIVE ON TO FINISH THE WORK WE ARE IN; TO BIND UP THE NATION'S WOUNDS; TO CARE FOR HIM WHO SHALL HAVE BORNE THE BATTLE, AND FOR HIS WIDOW AND FOR HIS ORPHAN; TO DO ALL WHICH MAY ACHIEVE AND CHERISH A JUST AND LASTING PEACE AMONG OURSELVES AND WITH ALL NATIONS."

•

Reprints of this picture, suitable for framing, will be furnished without charge upon request on your company letterhead.

•

Reproduced in the interest of national unity and cooperation by

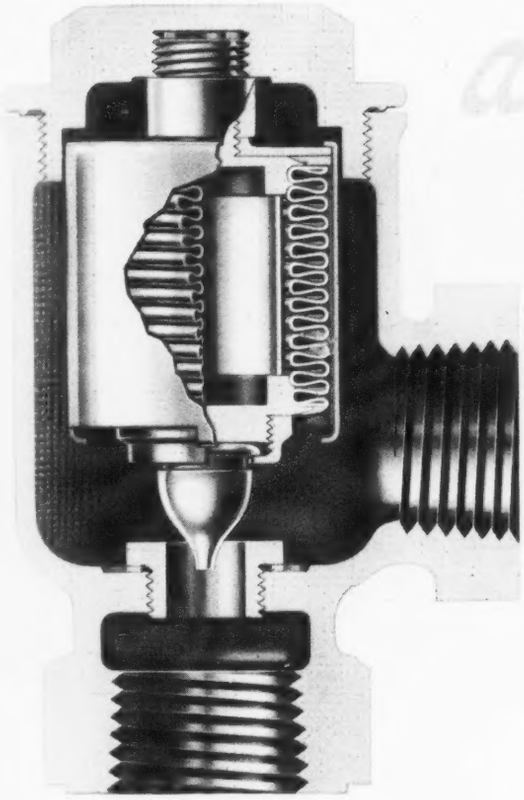
ROBINS CONVEYING BELT COMPANY

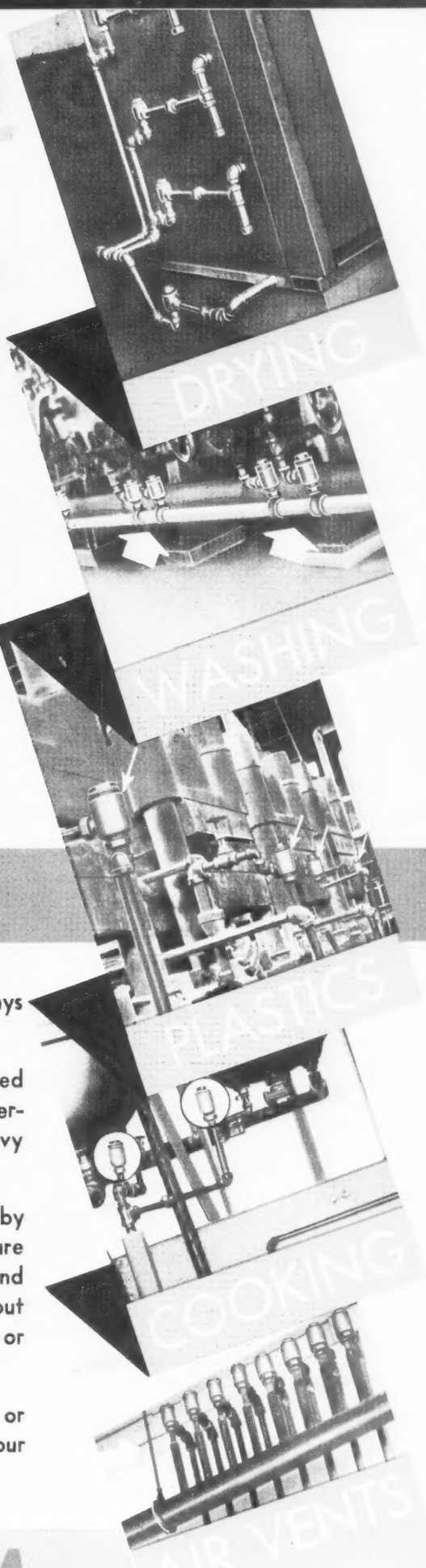
designers, manufacturers and erectors of complete plants and machinery for bulk materials handling.

PASSAIC, N. J. • NEW YORK • CHICAGO • BOSTON • CLEVELAND • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • DETROIT • CHARLESTON, W. VA.

TURN ON *all-out* HEAT

WITH SARCO STEAM TRAPS





AND KEEP IT ON. It's not enough to have steam in the boilers these days—it must travel, condense and return at an ever-faster rate.

And to conserve fuel, the trap must allow all the heat to be extracted before it opens. Some order! But that is just what the Sarco No. 9 Thermostatic Steam Trap has been doing for years—particularly in the heavy heat consuming industries illustrated on this page.

The No. 9 is famous for its positive acting bellows mechanism, made by special machinery in our new plant, devoted exclusively to the manufacture of steam traps and control. It is distinguished by its ability to open and discharge quickly and operate satisfactorily at all steam pressures without adjustment. The No. 9 also serves as an air vent—will not stick, freeze or bind. It is small, inexpensive and easy to install.

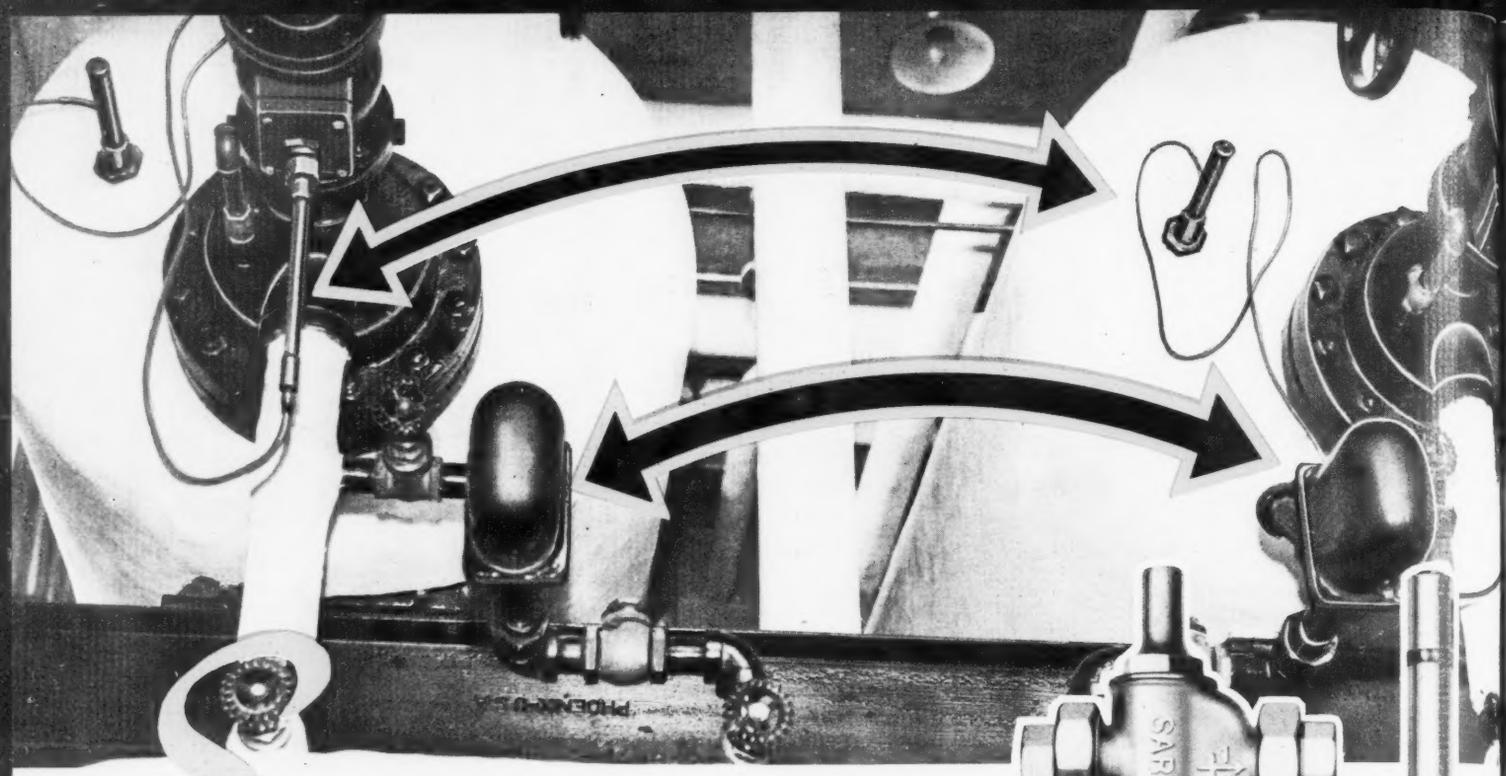
If you want to speed up, try one on each coil of your busiest machine, or ask our representative to show you where a few No. 9's will speed up your plant most. Catalog No. 250.

SARCO SAVES STEAM

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK, N. Y.

SARCO CANADA, LTD., TORONTO, ONT.

Represented in Principal Cities



Save WATER . . .

SAVE HEAT . . . SAVE TIME *with*

SARCO HOT WATER TEMPERATURE CONTROLS

Yes—many times it saves all three on a single job. Water too hot or too cold is often wasted in the plant, and the b.t.u.'s you paid for go down the drain with it.

In process work a few degrees, up or down, in water temperature can produce a slow-up, rejects or even shut-downs.

You can connect up a Sarco TR-21 Temperature Regulator in a day, save its cost in a few weeks—benefit by it for years.

ASK THE MEN AT YOUR MACHINES

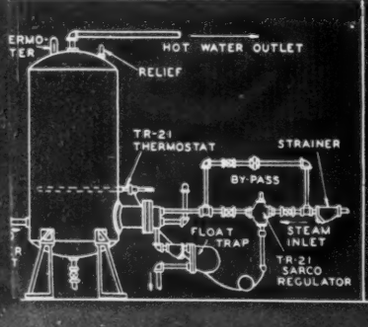
All through your plant there are men working under conditions that could be speeded up at a saving in fuel cost, with temperature control.

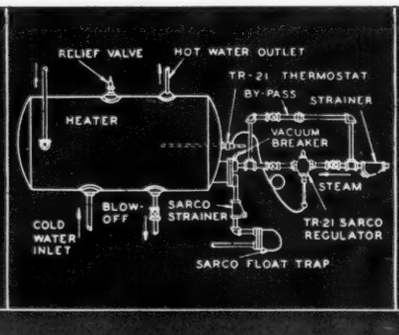
Start with your hot water heaters—check your tanks, condensers, heat exchangers and stills. How about the temperature of the room—or even the ice water? Look into every spot where temperature counts—you will find many practical applications for Sarco hot water or cooling controls.

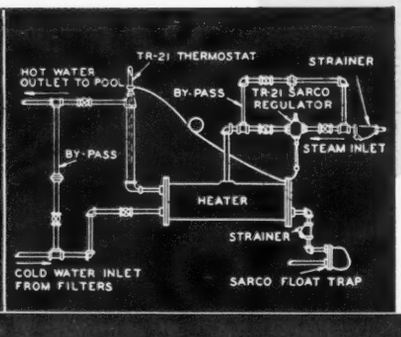
Why not ask the nearest Sarco representative to go over your plant with you?

SARCO CANADA, LTD., TORONTO, ONT.

Represented in Principal Cities



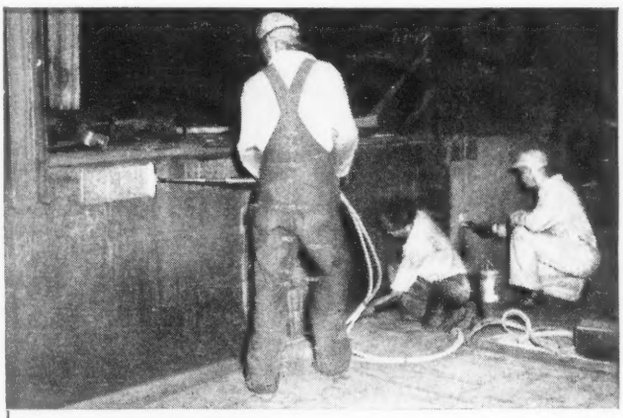




OXY-ACETYLENE FLAME-PRIMING makes paint go on faster and last longer . . .

1. What it is and does

Oxy-acetylene flame-priming is performed by passing the flame from an Oxweld heating head over structural steel before the first protective coating is applied. The quick heat causes rust and loose scale to pop off, and drives out the surface moisture, thus leaving a clean, dry surface for the paint. Structures of any size or shape can be flame-primed in the shop or on the job.



2. How it helps

Flame-priming is followed by wire-brushing, and close behind this comes the painting. As a result the metal is clean, dry, and still warm—making the paint go on faster, bond tighter, dry quicker, and last longer.

3. What you need to use it

All you need to use this method is an Oxweld W-26 heavy-duty welding blowpipe and an Oxweld flame-priming head, connected to an adequate source of oxygen and acetylene supply. Any operator can learn the technique quickly.

With standard welding heads, you can use your flame-priming equipment for heavy welding, and for straightening, forming, and other heating operations.

and Linde can help you use it!

Linde can supply the gases, the apparatus, and help in using flame-priming. If you are interested in giving longer life to paint jobs—or if you are confronted with bottlenecks in using sand-blasting equipment—*talk it over with Linde!*

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

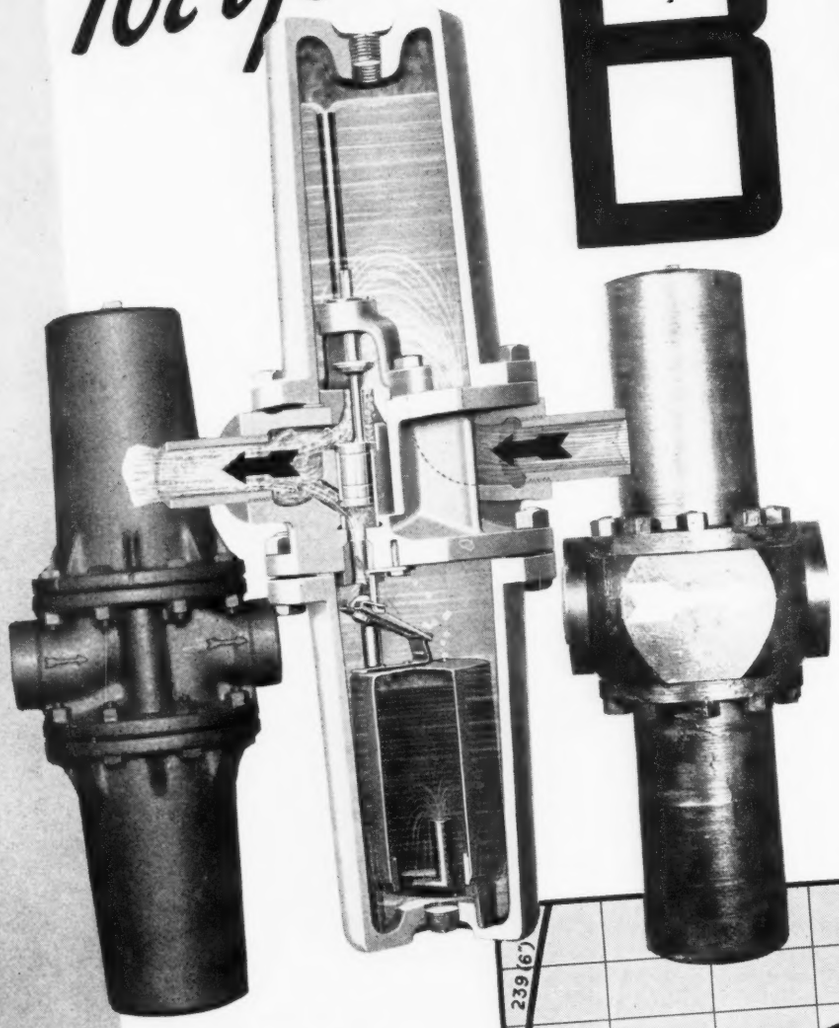
General Office: New York, N. Y. UCC **Offices in Principal Cities**

In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

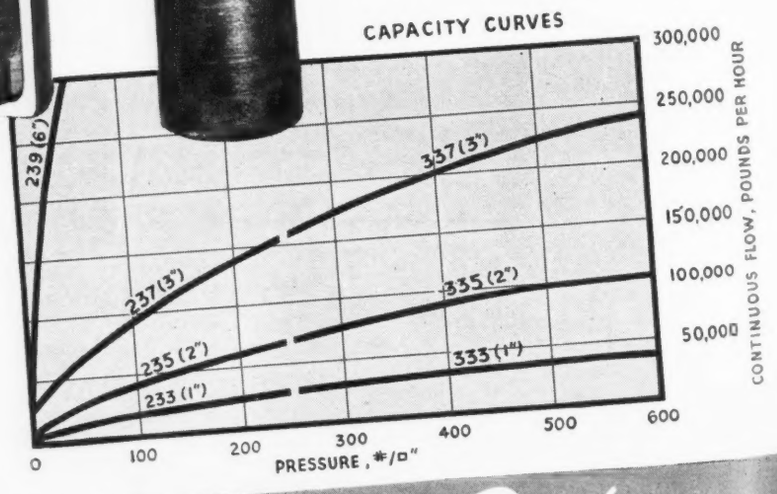
The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks of Units of Union Carbide and Carbon Corporation.

For Your BIG



A Complete Line

● ARMSTRONG COMPOUND TRAPS are built for 1", 2", 3" and 6" pipe connections. No. 233, 235, 237 and 239 have cast semi-steel bodies and are suitable for steam pressures up to 250 lbs. No. 333, 335 and 337 have forged steel bodies with either screwed or flanged connections. See chart below for capacities.



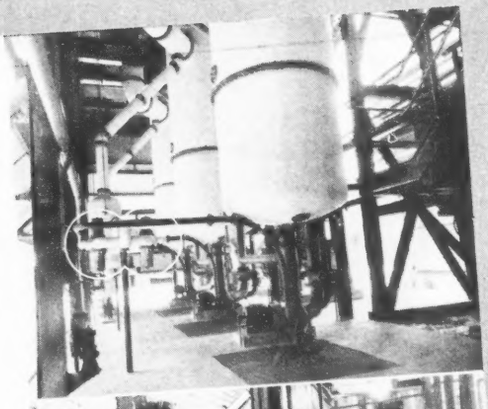
FOR CATALOG

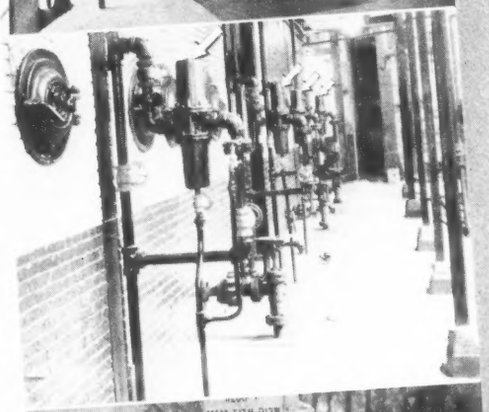
● Detailed specifications and information about Armstrong Compound Traps are printed in Catalog H. Ask for a copy.

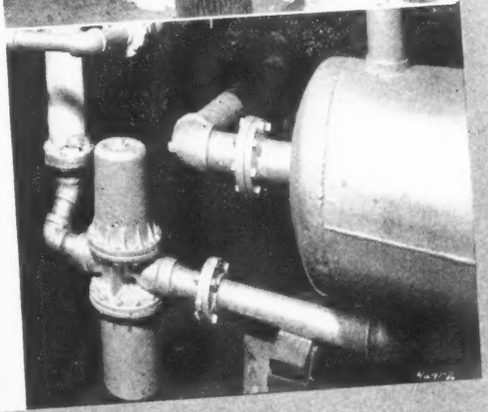
ARMSTRONG MACHINE WORKS
812 Maple Street
Three Rivers, Michigan

ARMSTRONG Piston Operated

CONDENSATE DRAINAGE *Jobs*







QUICK ACTING. Armstrong Piston Operated Compound Traps get rid of big slugs of water in a hurry without any steam loss. Completely automatic. The capacity curves shown at left are drawn from actual tests with hot condensate. The valve action is fast and positive.

SINGLE, SELF-CONTAINED UNIT. Entire mechanism for handling BIG drainage jobs is housed in a compact assembly and actually consists of only three moving parts.

HIGHLY DEPENDABLE. No springs . . . no closed floats . . . no adjustments to make. You get all the advantages of standard Armstrong traps: non-air-binding . . . self-scrubbing . . . tight closing, no wire-drawing . . . valves water-sealed at all times . . . all-stainless steel interior mechanism.

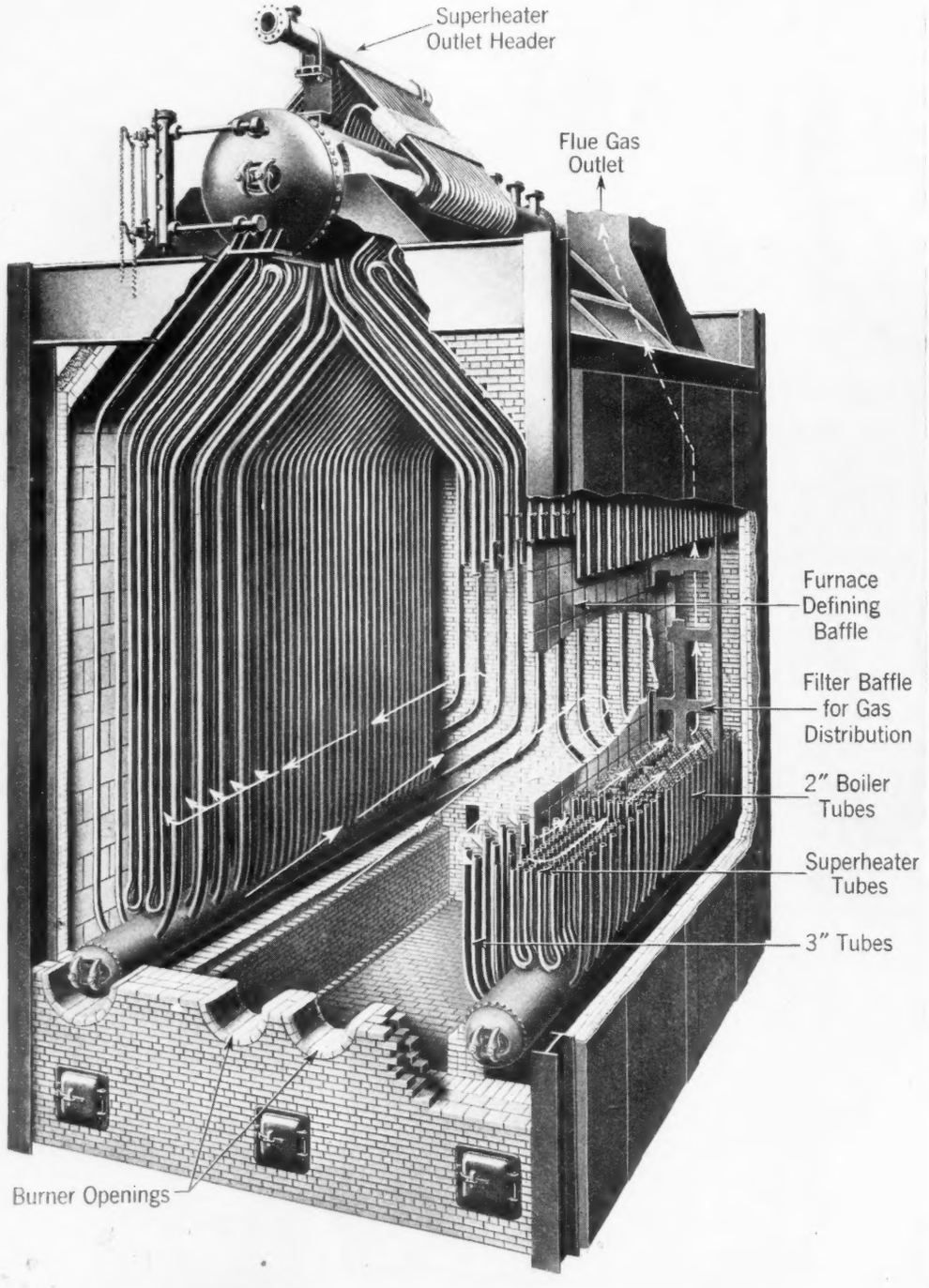
MANY USES:

• Following is a summary of a few typical installations of Armstrong Compound Traps:

Trap:	Pressure:	Draining:
No. 235	165 lbs.	Marley Purifier
No. 333	300 lbs.	Ross Heater
No. 237	175 lbs.	Swenson Evaporator
No. 335	650 lbs.	B & W Separator
No. 235	150 lbs.	Mica Press
No. 337	450 lbs.	Hagan Purifier
No. 235	150 lbs.	Sand Dryer
No. 233	200 lbs.	Creosoting Cylinders
No. 235	140 lbs.	Griscom-Russell Extraction Heaters
No. 233	65 lbs.	Alum Cooking Vats
No. 335	1100 lbs.	Gas Well Separator
No. 237	15 lbs.	Paper Machine Dryers
No. 235	150 lbs.	Centrifix Separator
No. 235	125 lbs.	10,000 gal. Sims Water Heater
No. 437	1000–150 lb	Desuperheater
No. 337	450 lbs.	Boiler Dry Drum
No. 237	175 lbs.	Morterud Heaters
No. 235	80 lbs.	Oil Separators
No. 235	50 lbs.	Pulp Digester Heater
No. 233	5–110 lb	Salt Grainer Pan
No. 237	200 lbs.	Continuous Blow-down System

COMPOUND TRAPS

"S-A" BOILER



Perspective drawing of an "S-A" steam generator showing construction details of a reverse-fired unit. This drawing is scaled from an actual installation for 75,000 lb. steam per hour.

FW FOSTER

ADVANTAGES

DESIGN RANGE

Capacity—7000 lb. per hr. to 218,000 lb. per hr.
Pressure—125 lb. to 650 lb. per sq. inch
Final Steam Temp.—438° F. to 850° F.

FUELS

Coal: hand-fired, stoker fired, Pulverized; Oil; Gas; Bark Refuse; By-product Tar

OPERATING

1. ***Boiler surrounds furnace***

   More boiler tubes are exposed to furnace than with two-drum arrangement

   As sides of boiler are encased, the amount of brickwork required is reduced

2. ***High Efficiency***

   Cross flow of gasses
   Staggered tube arrangement

3. ***Low draft loss***

   Due to one straight pass of gas through boiler

4. ***Methods of firing***

   From front with gases entering boiler at rear

   From front with gases passing to rear, reversing, and entering boiler at front, giving unusually long flame travel.

   From both ends simultaneously, using different fuels.

REPRESENTATIVE USERS*

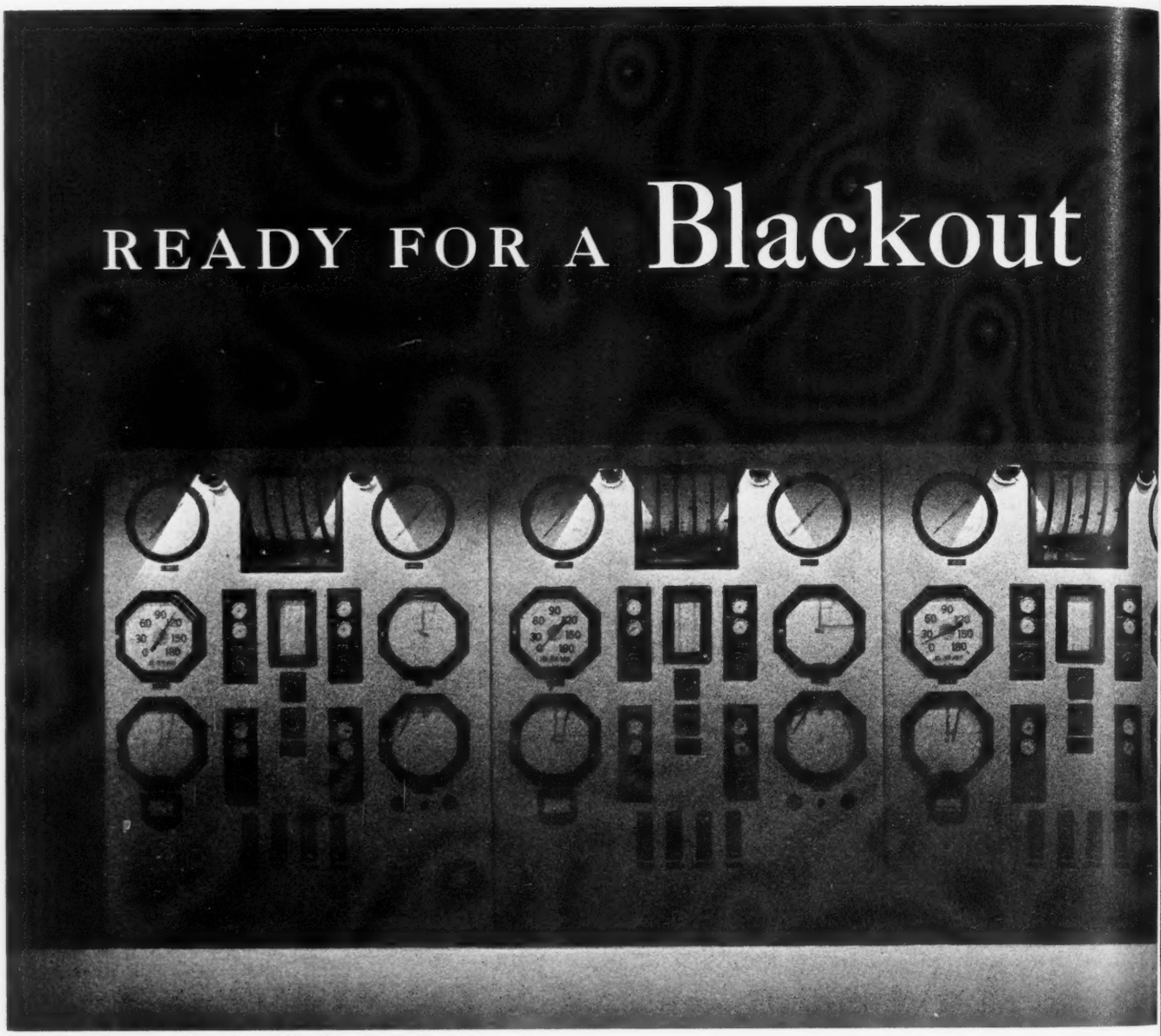
British American Oil Company Ltd.	Canadian Furnace Ltd.	Westinghouse International Company
Ontario Paper Company	City of Holyoke Gas & Electric Co.	Kansas Electric Power Company
Canadian Industries Ltd.	Shell Oil Company	Socony-Vacuum Oil Company
Cia. Textilera Ariquanabo	The Texas Company	Chemical Construction Company

***Each company operates two to seven "S-A" units—all having placed repeat orders.**

Foster Wheeler Corporation, 165 Broadway, New York, N. Y.

WHEELER

READY FOR A Blackout



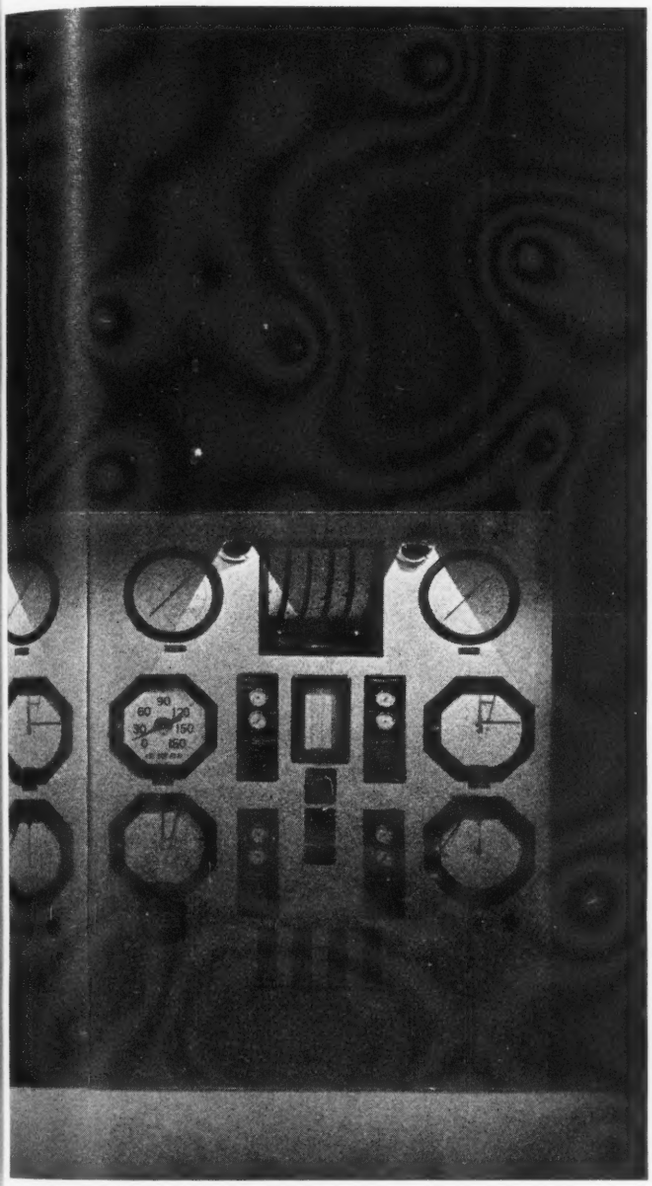
Republic boiler control panels supplied for a U. S. Army base.

TO provide for the complete automatic control of steam generating units, Republic combustion control systems are being installed in many of the new U. S. Army and Navy defense establishments.

The U. S. Government, in planning its new defense bases, must provide for all eventualities, even including the possibility of air attack. Vital to the operation of these highly-mechanized bases is the power plant, where all power services originate . . . power services that must be maintained without interruption if modern defense mechanisms are to function.

To guard against a possible power failure, it

EQUIPMENT • FACILITIES • PERSONNEL & EXPERIENCE
REPUBLIC
INSTRUMENTS
AND CONTROLS



is of utmost importance that the steam generating units be equipped with the necessary instruments and controls to assure their efficient, uninterrupted operation even during a blackout.

Republic controls and instruments provide this assurance of efficient, dependable operation.

★ ★ ★

These U. S. Government Plants Have Installed Republic Combustion Controls and Instruments

☆

U. S. Military Academy • West Point, N. Y.
U. S. Army, Ladd Field • Fairbanks, Alaska
U. S. Army, Lowry Field • Denver, Colorado
U. S. Army, Scott Field • Belleville, Ill.
U. S. Army, Northeast Air Base • Chicopee Falls, Mass.
U. S. Army, Elmendorf Field • Anchorage, Alaska
U. S. Army, Wright Field • Dayton, Ohio
U. S. Army, Patterson Field • Fairfield, Ohio
U. S. Army, Camp Blanding • Starke, Florida
U. S. Utah Gen. Supply Depot • Ogden, Utah

☆

U. S. Naval Academy • Annapolis, Md.
U. S. Naval Operating Base • Norfolk, Va.
U. S. Navy Yard • Portsmouth, Va.
U. S. Navy Yard • Pearl Harbor, Hawaii
U. S. Navy Yard • Charleston, S. C.
U. S. Naval Hospital • Newport, R. I.
U. S. Naval Air Station • Quonset Point R. I.
U. S. Naval Training Station • Great Lakes, Ill.
U. S. Naval Air Station • Argentia, Newfoundland
U. S. Marine Barracks • Quantico, Virginia

☆

U. S. Alabama Ordnance Plant • Childersburg, Ala.
U. S. Kankakee Ordnance Plant • Kankakee, Ill.
U. S. Picatinny Arsenal • Dover, N. J.
U. S. Weldon Springs Ordnance Plant • Weldon Springs, Mo.
U. S. St. Louis Ordnance Plant • St. Louis, Mo.
U. S. Des Moines Ordnance Plant • Ankeny, Iowa

★ ★ ★

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago, Illinois

"A" This automatic planimeter pen record shows steam flow in volume units and the time at which it was produced or used in any part of the 24 hour period, enabling you to easily analyze steam production and distribution.

"B" This record line shows rate of flow and enables the operators to maintain the most efficient boiler operation, thus effecting substantial fuel savings.

06408

BROWN

Totals flow as a cash register totals dollars

Steam IS money. Wasting steam boosts overhead—eats up income—shrinks profits. Steam accounting is serious business—it needs business methods.

As a modern cash register guards a storekeeper's dollars—producing a printed record of each transaction—so flow meters should guard your power and process steam.

With Brown Flow Meters measuring the flow of fluids for power, heating and processing, you are completely protected—because The Brown Automatic Recording Planimeter Pen, "A", making the marginal record shown on the chart pictured supplies the PROOF that a definite number of pounds of steam, gallons of water, cubic feet of gas, or barrels of oil, were delivered, utilized—or wasted.

This is a special, patented feature of the greatest value to flow meter users. Reference to the automatic planimeter pen record on chart rim assists you to distribute departmental or process loads more uniformly over the working day, effecting substantial fuel savings not only in the boiler room but in every department or unit where steam is used.

In addition, Brown Flow Meters offer you other advantages such as:

Six inter-related range tubes with inter-related direct reading charts.

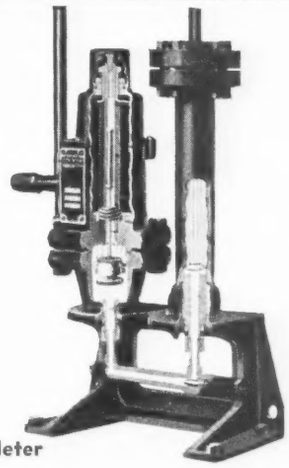
Meter Bodies for working pressures up to 2500 lbs.

Integrator dial—easy to read—insures highly accurate totalizing at all rates of flow from 0-100%.

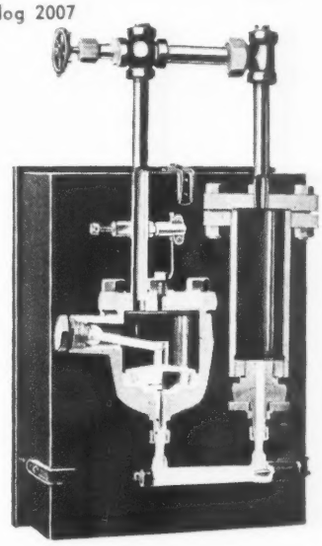
Universal case permits any style panel mounting—flush on panel, front-of-board or on wall.

Indicating, Recording and Controlling models—Electrical, Mechanical and Area types for all applications.

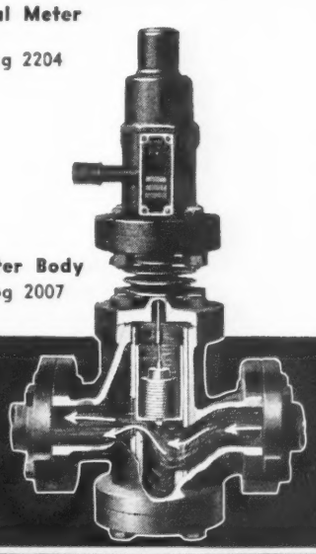
Get all the facts about Brown Flow Meters. Features are fully explained in Catalog No. 2007. Send for your copy. THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Co., 4490 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland. Wijdesteeg 4—England: Wadsworth Road, Perivale, Middlesex—Stockholm, 16, Sweden: Nybrokajen 7.



Brown Electric Meter Body
Write for Catalog 2007



Brown Mechanical Meter Body
Write for Catalog 2204



Brown Area Meter Body
Write for Catalog 2007

Flow Meters

Accurate Measurement with Simplicity

Right in step

THEY PREFER TEXACO

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

YOUR GOVERNORS WILL function efficiently, keeping turbo-generators at the correct speed, regardless of load, when they are lubricated with *Texaco Regal Oils.*

Texaco Regal Oils separate rapidly from air and water, are highly resistant to oxidation, emulsification, gum formation, and sludging.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by operators of thousands of turbines everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distribution points in the 48 States, or write:

The Texas Company, 135 East 42nd St., New York, N. Y.

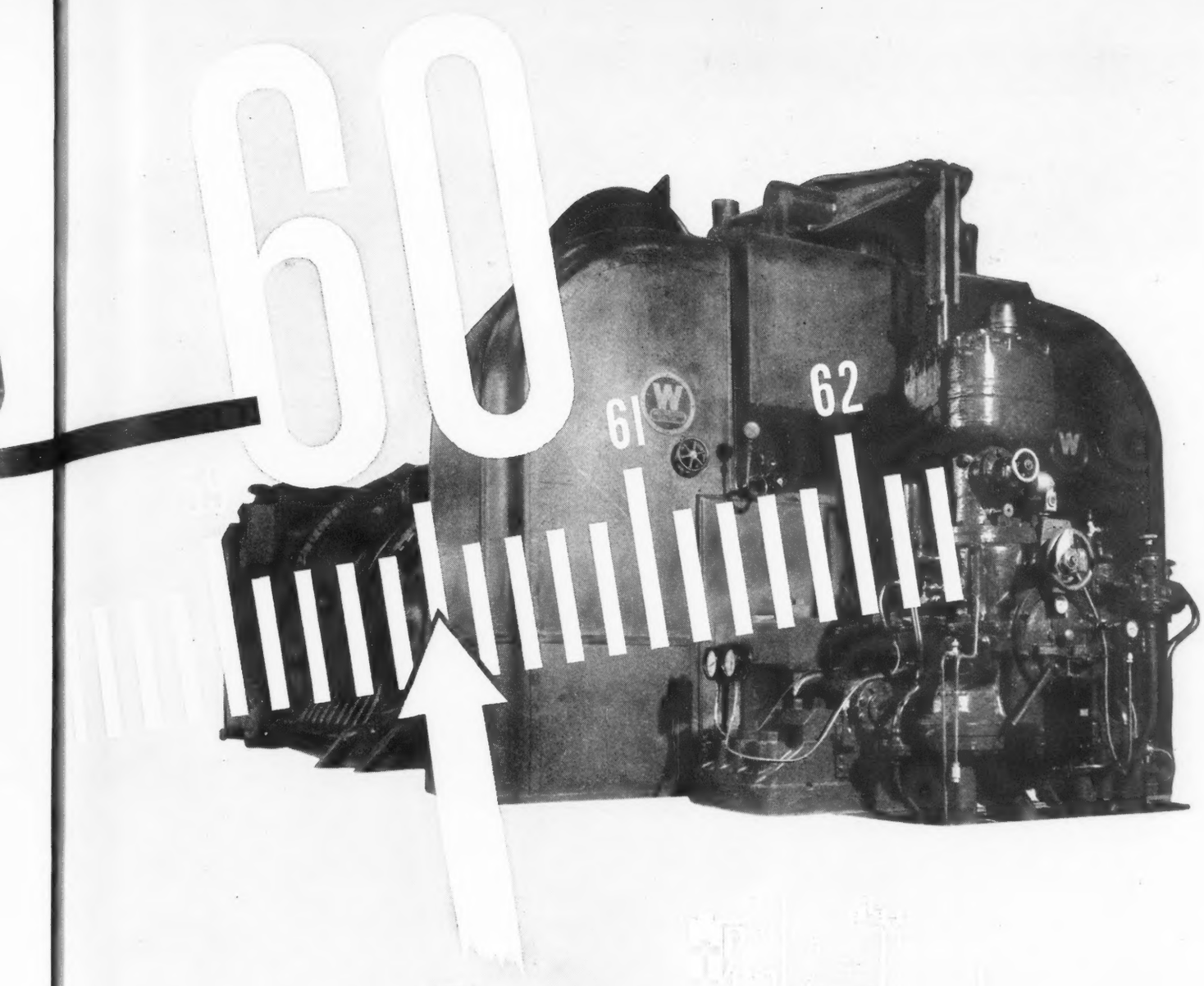
FOR YOUR ENJOYMENT—TWO GREAT RADIO PROGRAMS

FRED ALLEN every Wednesday night. See your local newspaper for time and station.

METROPOLITAN OPERA. Complete broadcasts of great operas every Saturday. See your local newspaper for time and station.

TEXACO

TEXACO



THIS HIGHLY COMPLEX, but efficient speed governing system is not only oil lubricated but oil-operated. The stability of this oil largely determines the freedom of the entire mechanism from the possibility of sticking and sluggishness.

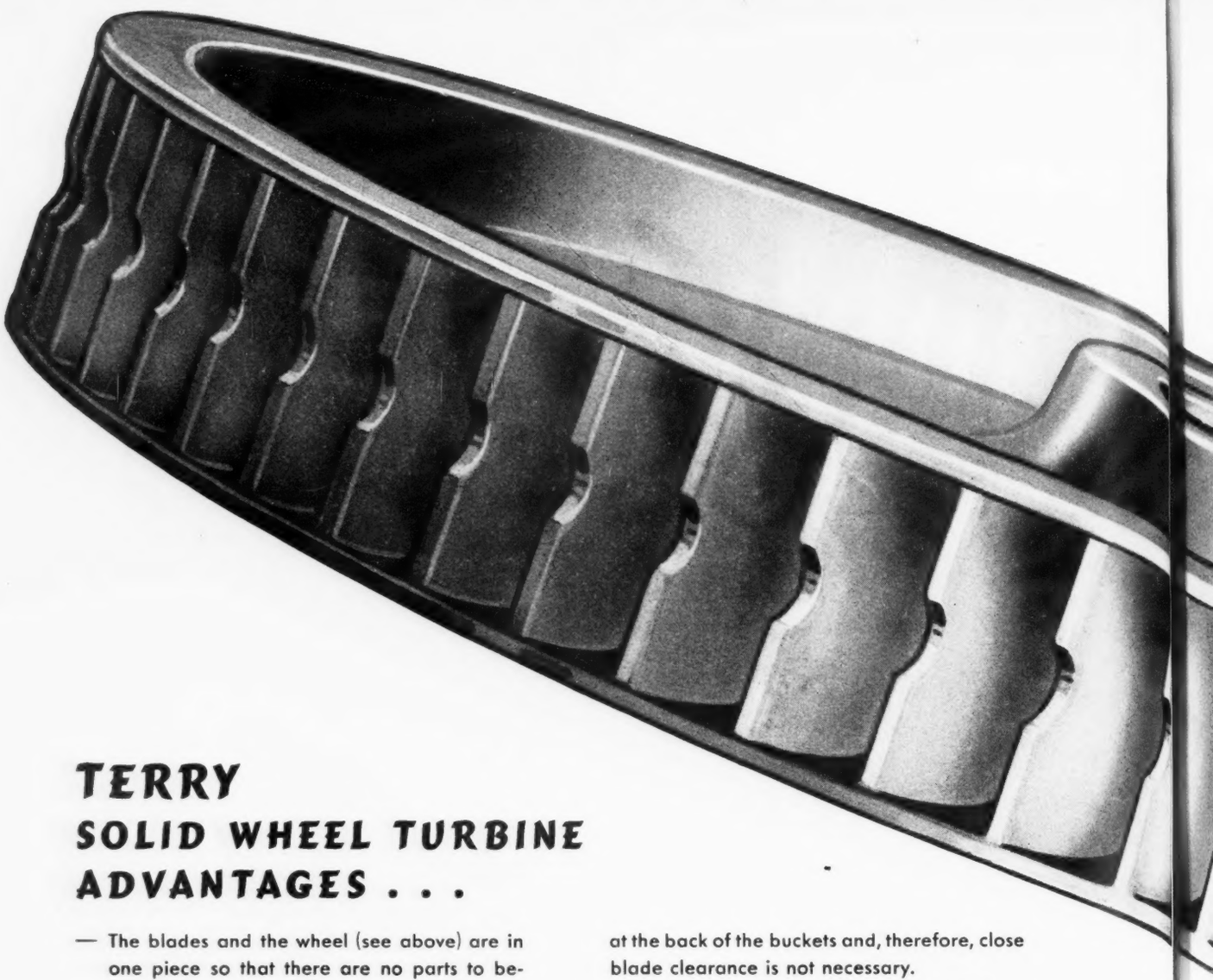
Thousands of turbine governors are kept instantly responsive to fluctuating loads with *Texaco Regal Oils.*

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for War Needs.

REGAL OILS

FOR ALL TURBINES

The TERRY



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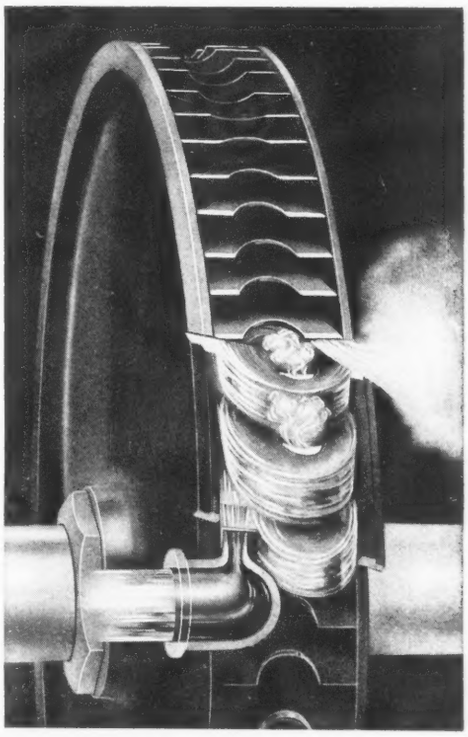
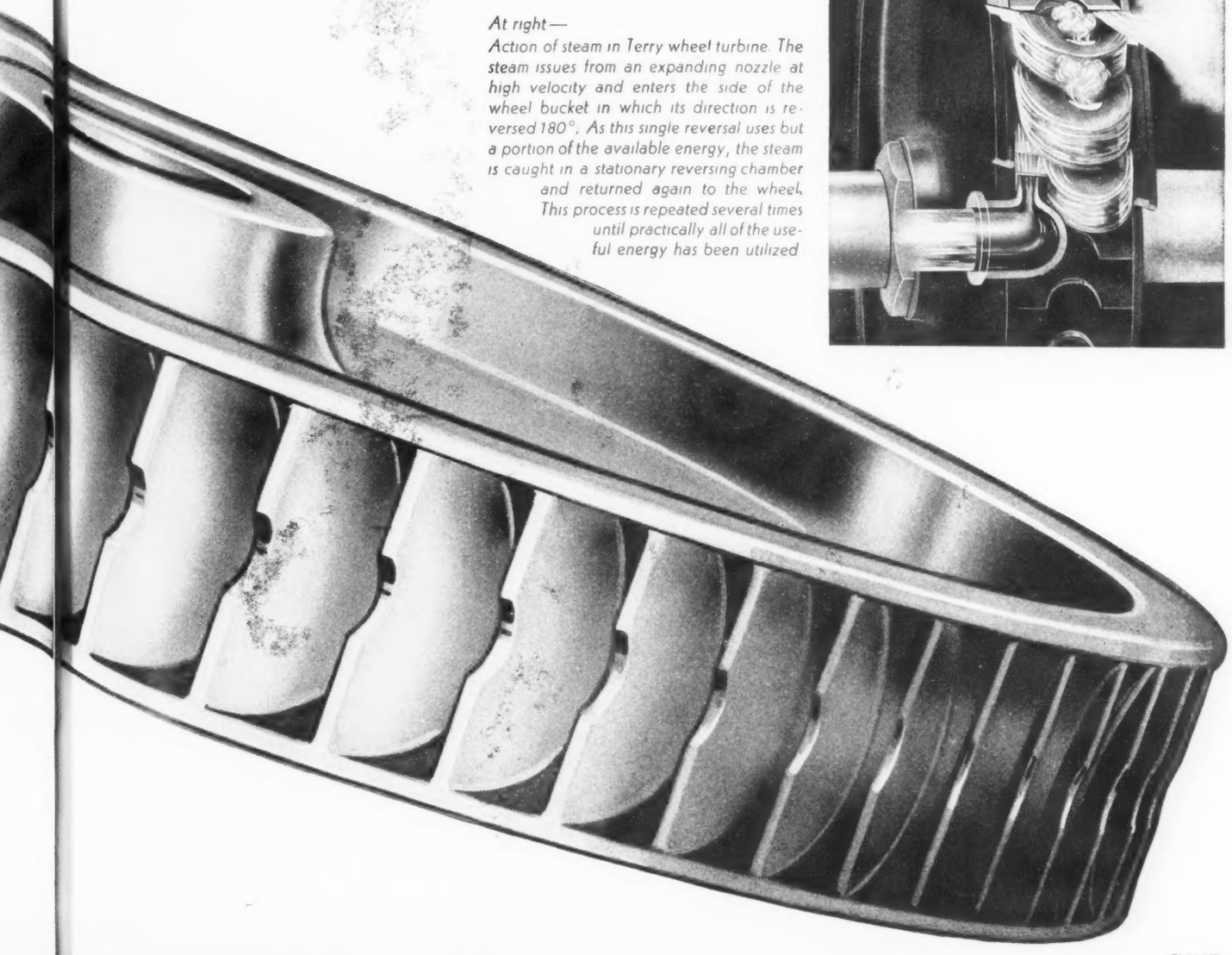


At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized



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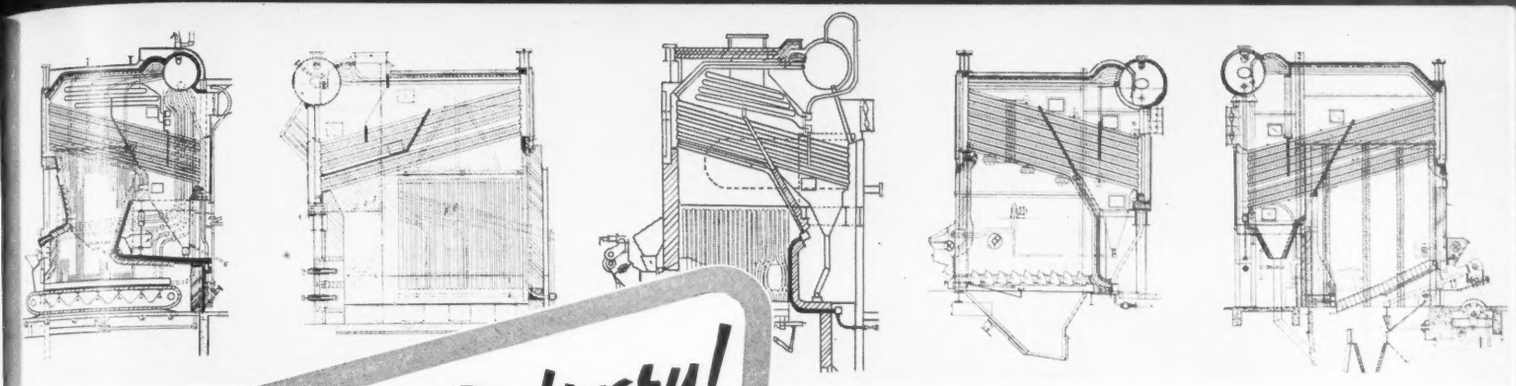

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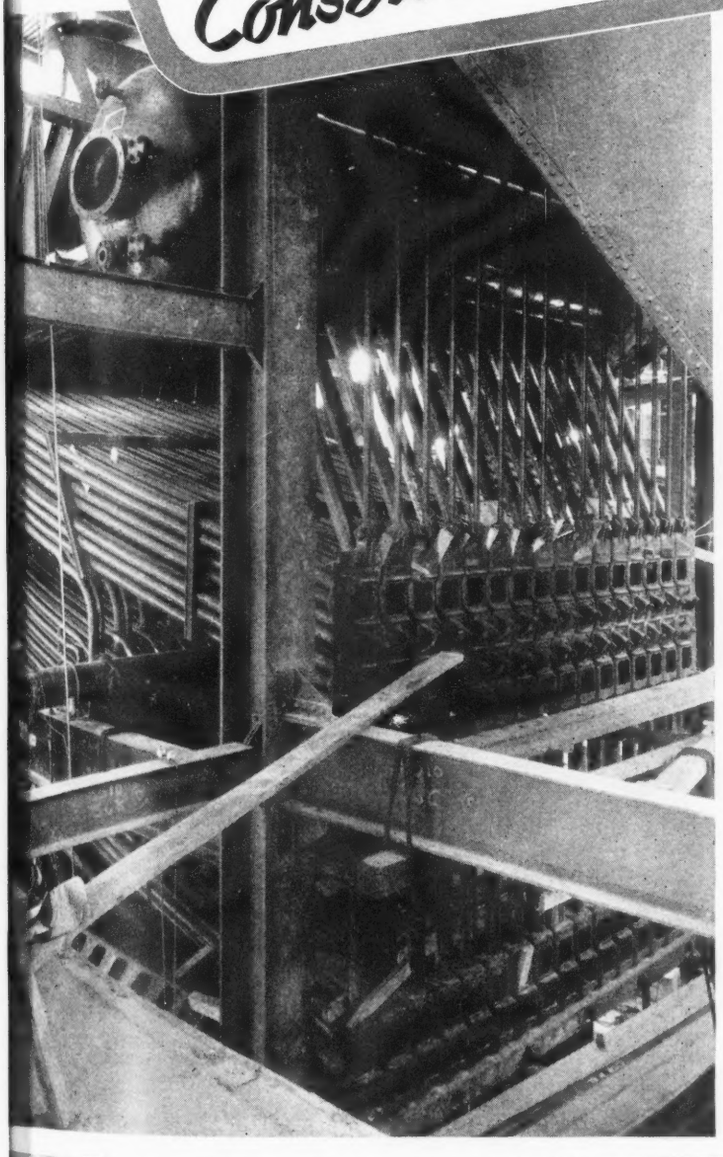

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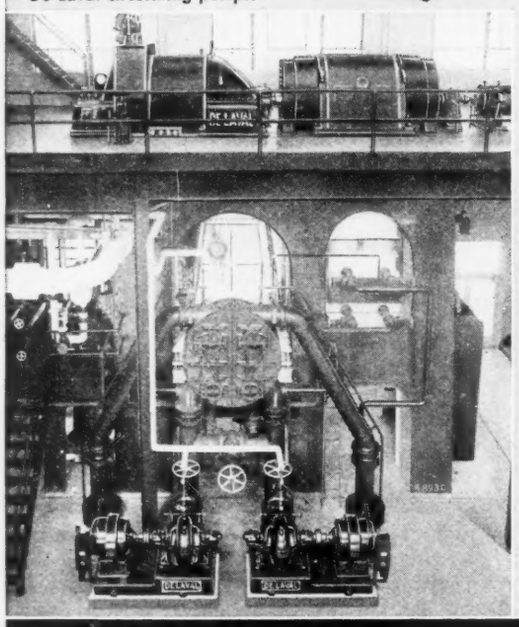
▼ Condenser installation, showing duplicate motor-driven De Laval circulating pumps.



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VOLUME 86, No. 2

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Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N. Y.

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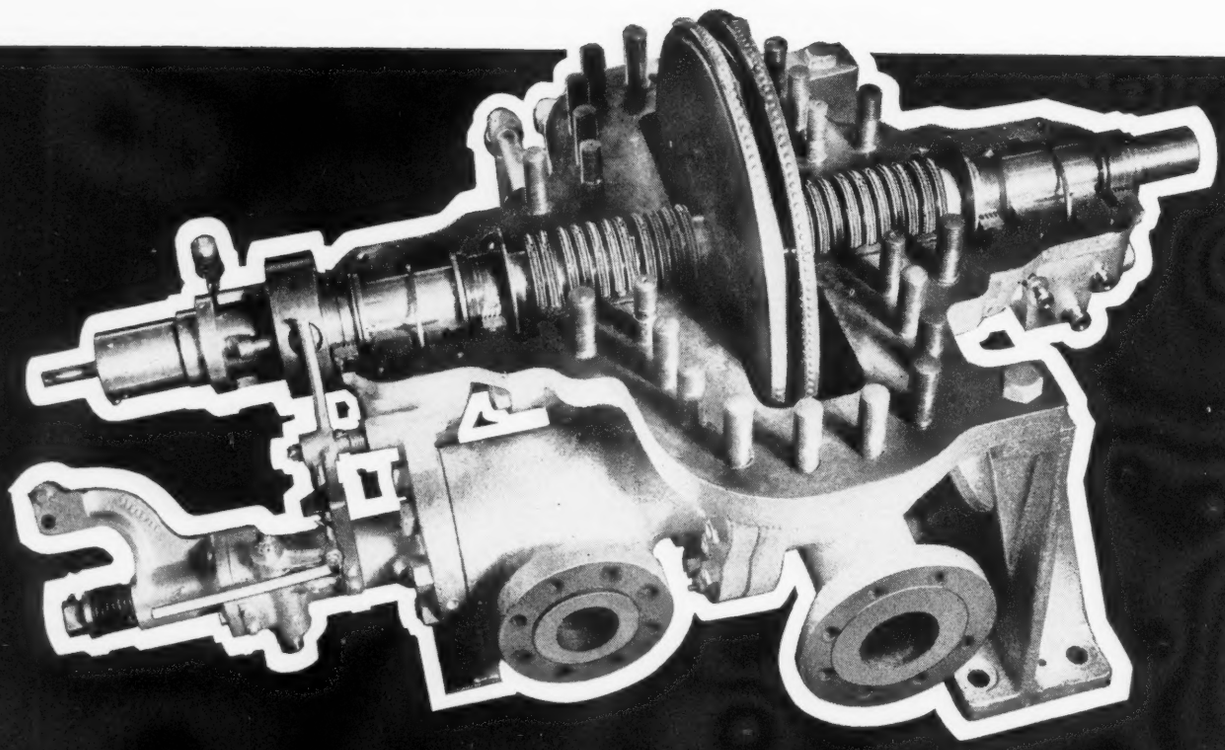

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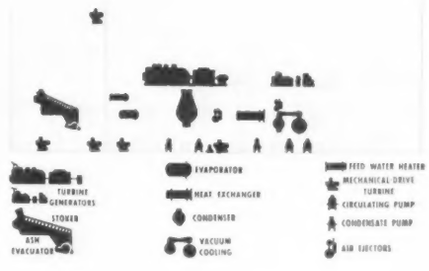

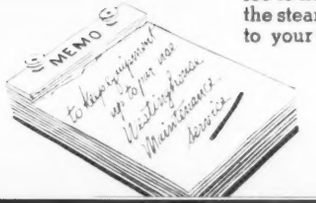

THE CHEAPEST REPAIRS ARE THOSE YOU DON'T HAVE

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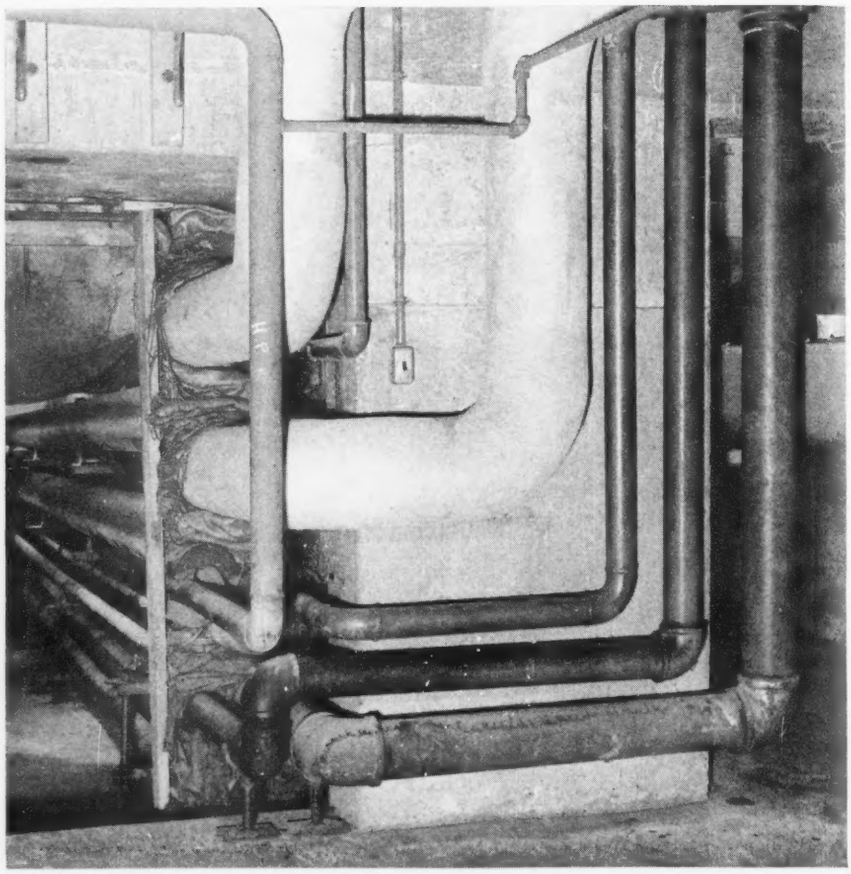
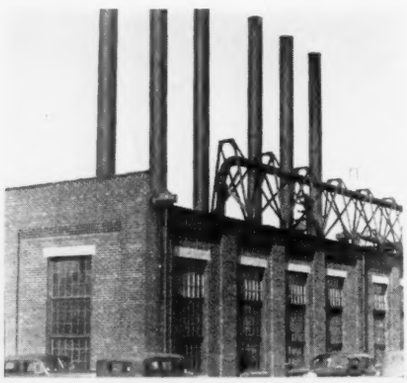
If you want to avoid repairs—and what engineer doesn't—it will pay you to check on the experience of other plant men with wrought iron in services where corrosion or fatigue limit the life of ordinary materials. The longer life of wrought iron under these conditions is confirmed by engineering records. If you will write details of your problem, our Engineering Service Department will be glad to give you data on the performance of wrought iron in similar situations.

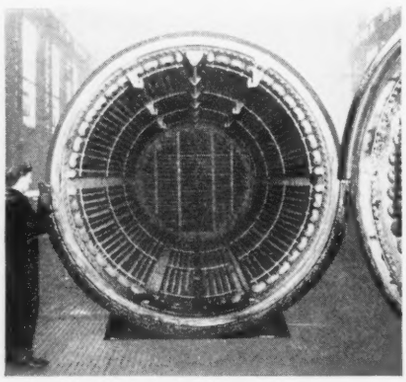
A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.



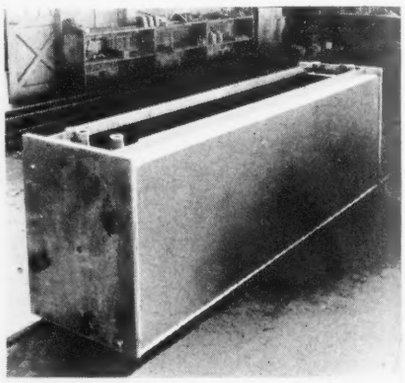
To avoid frequent and costly repairs in brewhouse piping, Griesedieck-Western Brewery Co., Belleville, Ill., used Byers Wrought Iron in six of the lines illustrated: 8" steam supply line, 8" exhaust line, 4" and 6" cold water lines, and two 3" condensate lines. Our bulletin, "Wrought Iron for Piping Systems," illustrates and describes many varied applications. Ask for a complimentary copy.



Stack corrosion has been aggravated in many plants by the necessary use of lower-grade coal. These six stacks—all wrought iron—indicate how many engineers are successfully meeting this problem. Ask for our bulletin, "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment."



Piping in special equipment—like this vulcanizer—is often exposed to severe corrosion and a shut-down cuts plant output. Wrought iron is helping to eliminate frequent repairs here and in dozens of similar jobs. For further details, ask for our bulletin, "101 Uses for Wrought Iron."



Processing operations often require the handling of highly corrosive liquids; the tank illustrated carries sodium nitrate. The use of wrought iron here cut repairs and replacements to less than half previous experience. "Wrought Iron for Tank Construction" gives other examples.

Corrosion costs you more than Wrought Iron

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

MORE POWER FROM EXISTING EQUIPMENT—1

Practical suggestions for increasing capacity quickly and with minimum use of strategic materials

Draft Systems

Increasing available draft, where it is the limitation, steps up boiler output and so adds to the nation's power supply for the battle of production. Associate Editor S A Tucker here sets down practical pointers gleaned from nearly a hundred actual cases experienced by fan-doctor Jack Cassie, B F Sturtevant Co, and duct-designer G A Doremus, Consolidated Edison Co of New York

Editor's Note: This first article of several dealing with ways to obtain more steam and power from existing equipment parallels a program now under consideration by the Office of Production Management.

POWER will gladly refer to the authors inquiries concerning the application of methods outlined here to specific plants faced with draft limitations.

▶ IN THE COMING MONTHS of war effort, many industrial plants will be called on to operate at maximum output. Utilities will have to depend more and more on older equipment. Efficiency, long the goal of engineer and operator alike, now becomes a secondary consideration. A few thousand extra pounds of steaming capacity, however, obtained at small cost in strategic materials, will contribute much to tiding plants over this inevitable period of strain.

Ingenuity has progressively improved power-plant efficiency. The same ingenuity can be turned readily to increasing capacity. It matters little whether extra steaming capacity and the resulting kilowatts come from revamped firing equipment, more available draft, or some other source. Getting more power from existing units has become as important as shouldering a gun. Whatever is to be done must be done quickly and requires a minimum of precious materials and fabricating facilities.

Check Ductwork

Because the draft system limits maximum boiler load in many central-station and industrial plants, a rearrangement of ductwork to reduce pressure loss offers one of the best possibilities for increasing steaming capacity of existing equipment. Experience of the past several years proves that output can be stepped up at small cost in labor and materials by applying present knowledge of fluid-flow streamlining to air- and gas-handling systems of power boilers.

To make a start, ask yourself these questions: (1) Does fan or chimney draft limit boiler output in my plant?

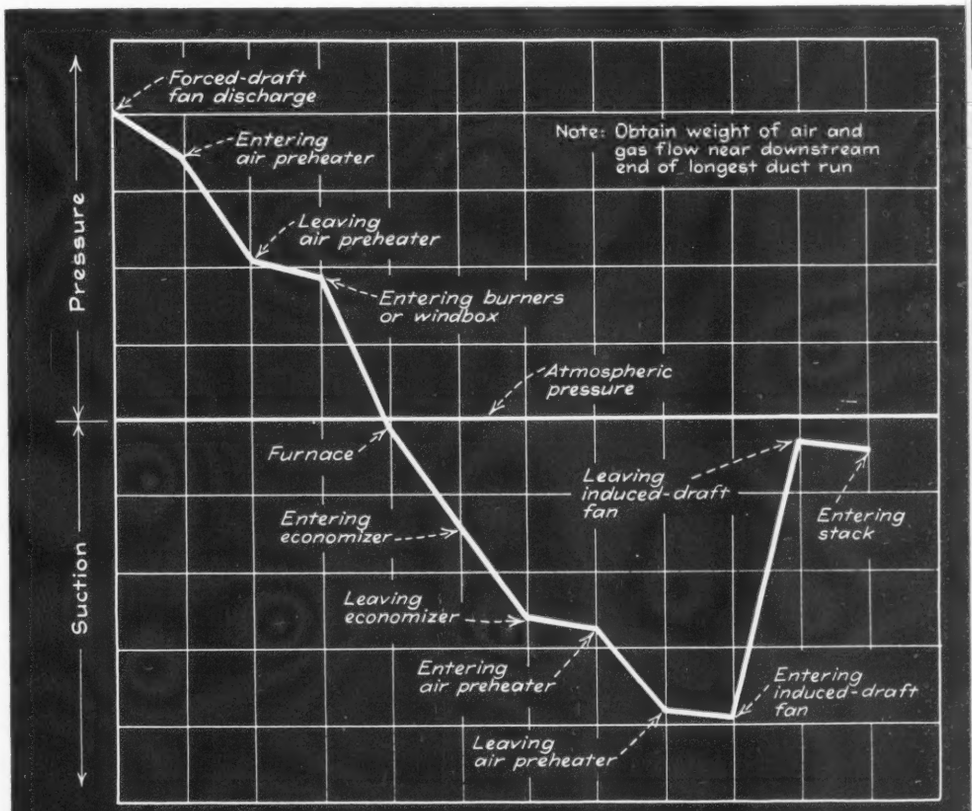


Fig. 1—To check a draft system, plot pressure readings at several strategic points to show where losses exceed design values. Make a traverse of the duct area with an impact pitot tube and determine the average pressure or suction at each station. At the same time, note air or gas temperature and record duct dimensions. Average velocity can then be calculated for each impact-tube station

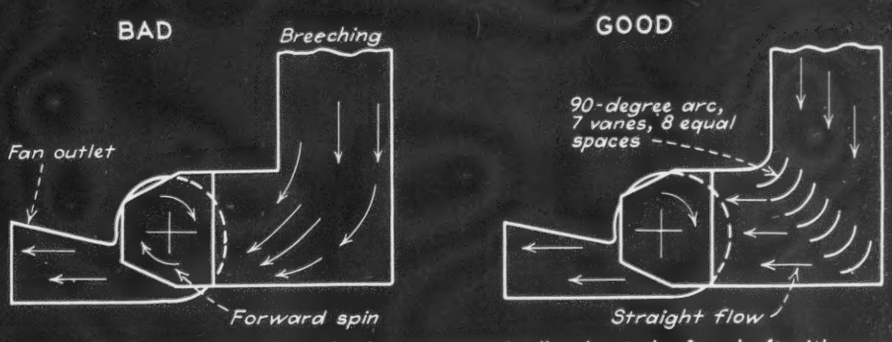


Fig. 2—Does gas enter fan inlet box symmetrically about the fan shaft with reasonably uniform velocity across the duct and with a straight flow path, or does duct transformation block part of fan wheel? Whirl or spin reduces fan capacity

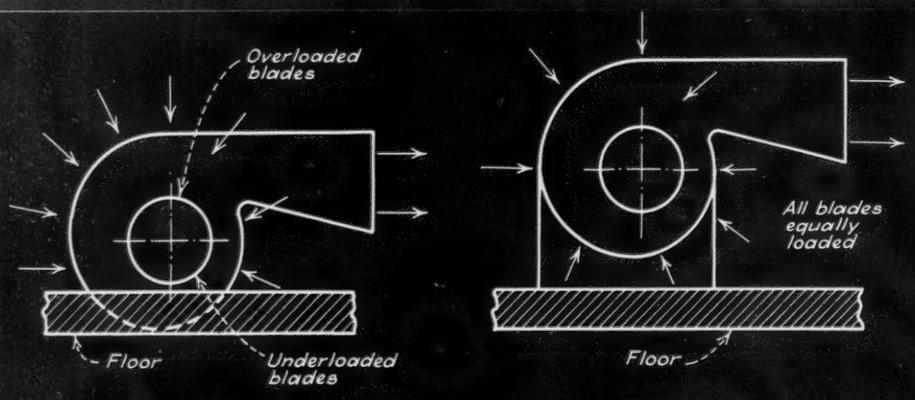


Fig. 3—Do open inlets of forced-draft fans have clear space for several feet in all directions to allow uniform radial approach of air or does some physical obstruction block part of fan wheel? Blocking prevents uniform blade loading

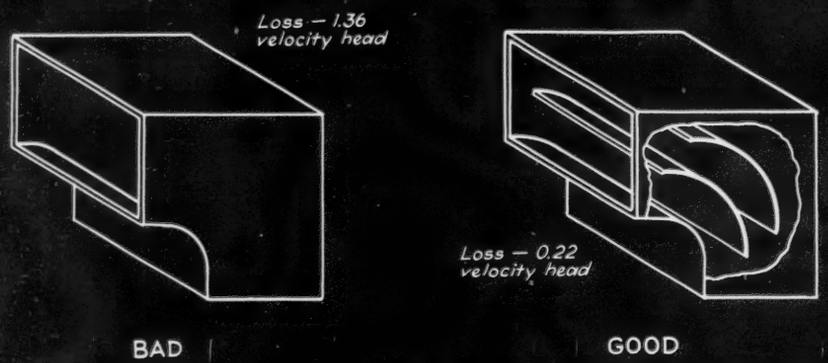


Fig. 4—Do turns in duct have correctly designed splitters to prevent crowding gas to the outside of the downstream area or does turbulence increase pressure loss four to six times more than necessary? Circular bent-plate corner turns can be made from salvaged steel and installed by operators during shutdown

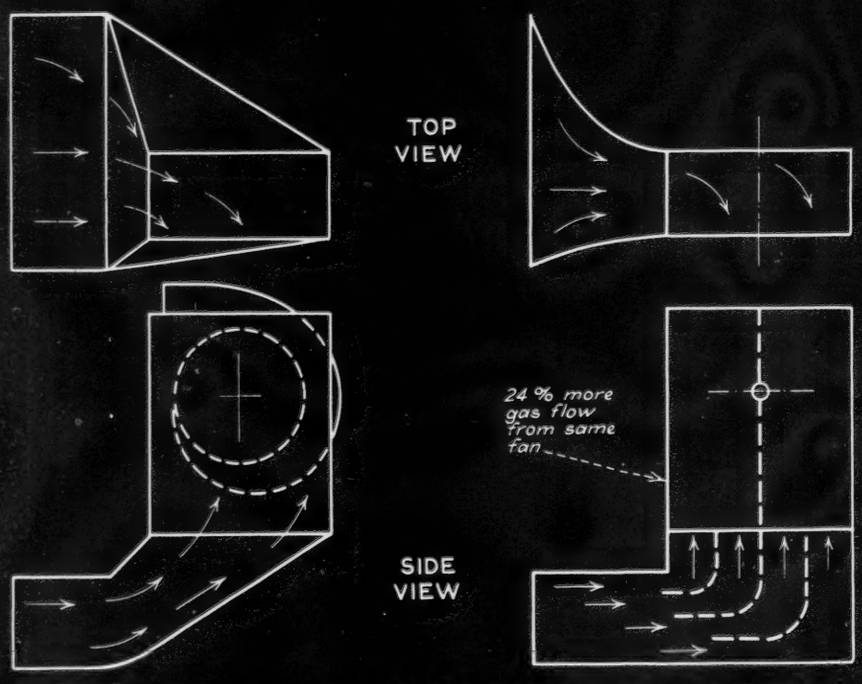


Fig. 5—Are transformation pieces gradually tapered, streamlined and free from turbulence or do sharp changes in direction or shape of duct set up spins? A turn can set up spins that use up many velocity heads in a few feet of travel

(2) Do any of the typical cases shown in Figs. 2 to 10 resemble a condition in my draft system?

These nine cases have been selected, classified, and simplified from actual plant experience. Each of the remedies suggested has been carried out and been found successful in at least one instance. They represent practical application of modern scientific knowledge of fluid flow—the same streamlining or "go-grease" that makes airplanes fly faster.

Typical Improvements

In Fig. 4, for example, it requires only one-sixth the pressure loss to turn a 90-deg bend if corner turns of simple design are properly located in the duct. Fig. 2 shows an actual instance of forward spin that cut the maximum volume that could be handled by the fan by more than 15%.

Perhaps one of the conditions represented in the drawings can be recognized by direct comparison with those in your plant. If so, the condition can be improved by direct application of the corrective principle illustrated. For example, the corner turns of Fig. 4 can be made by bending scrap steel plate around a 6-in. radius. Three or more of these, equally spaced and welded in the duct, will give 60 to 85% of the improvement that could be effected by an accurately designed corner turn.* Details of long-sweep guide vanes to accomplish the same purpose are also available.**

Pressure-Drop Survey

A more logical procedure involves starting from the beginning by finding out what pressure drop occurs in each duct section. Apparatus required is a simple impact (pitot) tube, Fig. 11, and considerable patience. At some reasonably constant load, preferably near maximum output, run a pressure traverse across the duct at several strategic points as indicated by the curve, Fig. 1. Instructions for making such traverses can be found in the Standard Test Code for Centrifugal and Axial Fans, published by the National Association of Fan Manufacturers, Detroit, Mich. It is usually sufficient, however, to divide the duct into a number of nearly equal areas and average the impact-tube readings.

In addition, it is desirable to determine the weight of air or gas flowing at the most favorable point for measure-

* "Design of Blade Elbows" by Loring Wirt, *General Electric Review*, June, 1927.

** Transactions of ASME, AER 58-2, 1935.

ment, usually at the downstream end of the longest straight duct run. Flow can be calculated from velocity-pressure readings, duct area and air or gas temperature, using the information in the aforementioned code or any standard handbook.

Information from such a duct survey can then be compared with rough-and-ready calculations of expected loss to indicate where improvement is possible. The methods of Figs. 2-10 suggest corrective measures.

In one recent case, the steaming capacity of six boilers was increased 25,000 lb per hr each, about the equivalent of a new boiler, at a cost of less than a ton of steel plate. Another set of guide plates, less than 500 lb of steel, netted 16,000 lb per hr of steaming capacity, about 0.03 lb of steel per added lb per hr of steam output.

Fan Performance

If a pressure-loss survey shows no prospect of increasing output by these means, attention then turns to other ways of increasing flow of air for combustion. Some thought given to fan-performance characteristics may suggest solutions to a specific problem entirely different from those yet mentioned.

Every operator knows that clean boiler surfaces result in greater heat absorption and higher efficiency. Removing soot and slag formations also increases the net cross-section for gas passage and consequently reduces draft loss. Usually overlooked, however, is the effect of sending cooler gas to the induced-draft fan. Cooler, and hence heavier, gas occupies less space and more can be handled by a given size fan at the expense of more fan power. More frequent and more effective cleaning will help carry continuous high loads.

Lower Air Temperature

Another entirely practical consideration is that of reducing air temperature at forced-draft fans. Opening windows or doors near open-inlet fans not only relieves the fan of a slight pressure drop in pulling part or all air through the boiler room but every 10-F fall in temperature increases actual weight of air the fan can handle about 2%.

If the limitation lies in the forced-draft system, the possibility of introducing overfire air over a stoker fuel bed should not be overlooked. A separate fan of relatively small volume size but of high enough pressure to jet an air stream well into the furnace not only can provide more air but also provides turbulence where most needed.

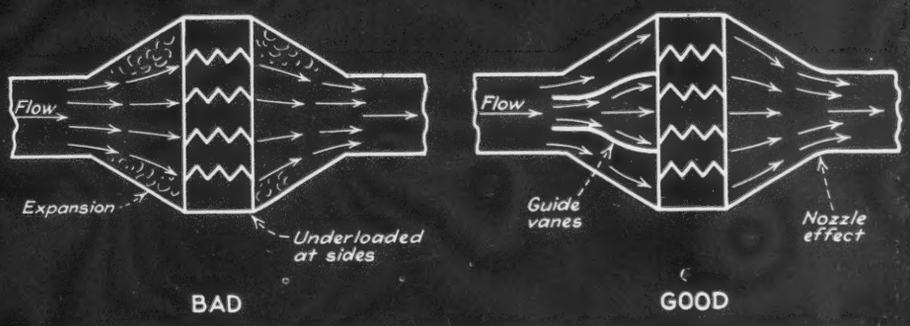


Fig. 6—Are large duct cross-sections fully utilized to obtain actual low velocities or does turbulence result in unnecessarily high pressure loss? Guide vanes and streamlined corners help to distribute flow over the duct cross-sectional area

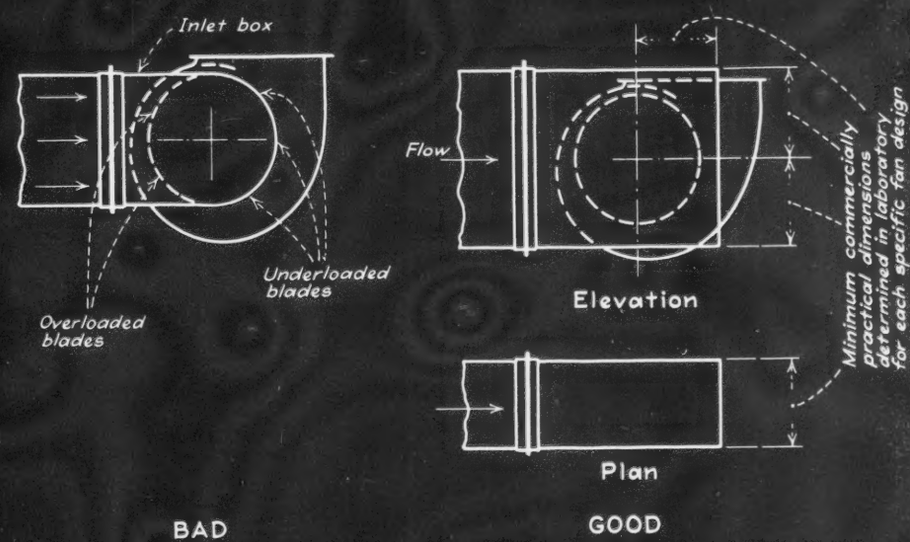


Fig. 7—Are inlet boxes suited to individual fans in light of present knowledge of inlet-box influence on fan performance or do older units suffer from spin or reduction of capacity by small entrance connections? Spin reduces fan capacity

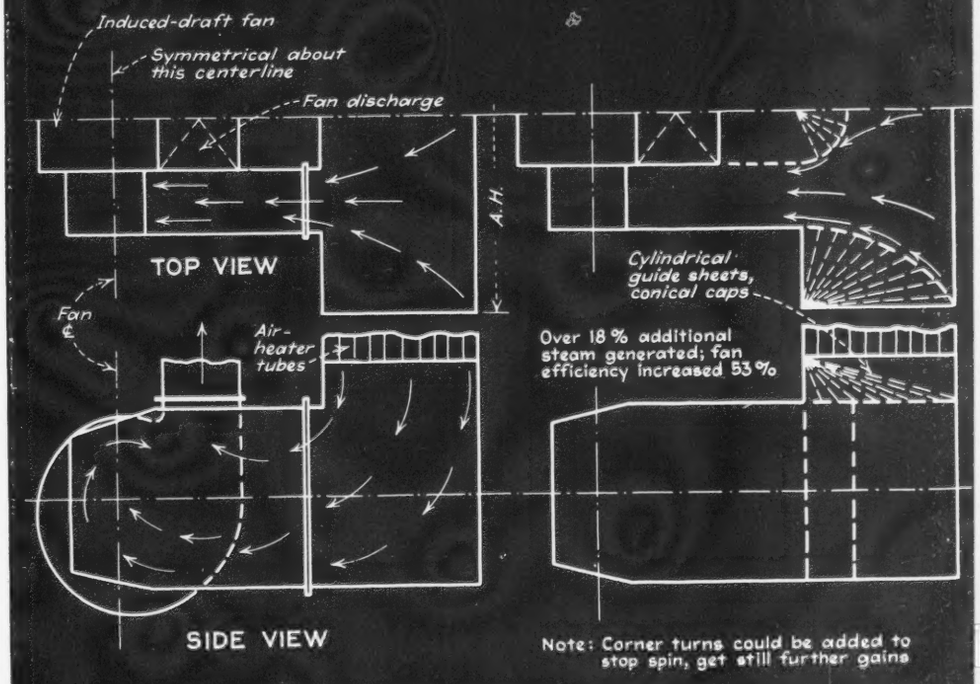

Induced-draft fan
Symmetrical about this centerline
Fan discharge
TOP VIEW
A.H.
Cylindrical guide sheets, conical caps
Fan
Air-heater tubes
Over 18 % additional steam generated; fan efficiency increased 53 %
SIDE VIEW
Note: Corner turns could be added to stop spin, get still further gains

Fig. 8—Is connection from wide air heater or economizer to narrow inlet box made in easy sweeps so that air actually follows transition or do eddies cut 15-20% from fan capacity? Flow-nozzle effect insures minimum end contraction

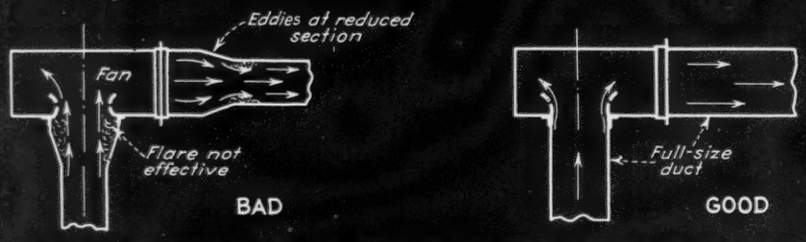


Fig. 9—Are duct sections leading to and from the fan of the same size and shape as the inlet and outlet pieces purposely selected by the designer or do transformation pieces cause throttling or spin? Flares and reductions cause eddies

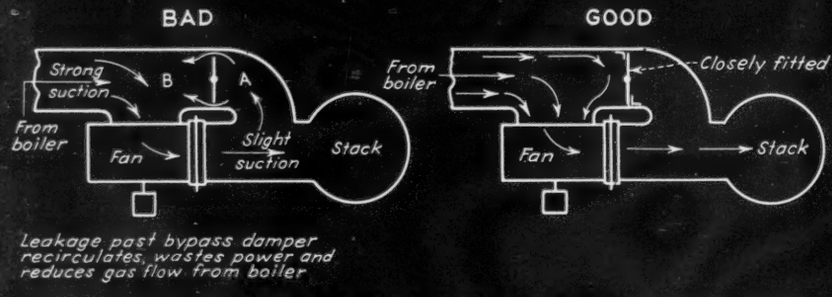


Fig. 10—Are bypass dampers absolutely tight or does poor fit permit unnoticed recirculation to the fan inlet? High differential pressures near induced-draft fans cause large leakage even through small cracks around bypass dampers

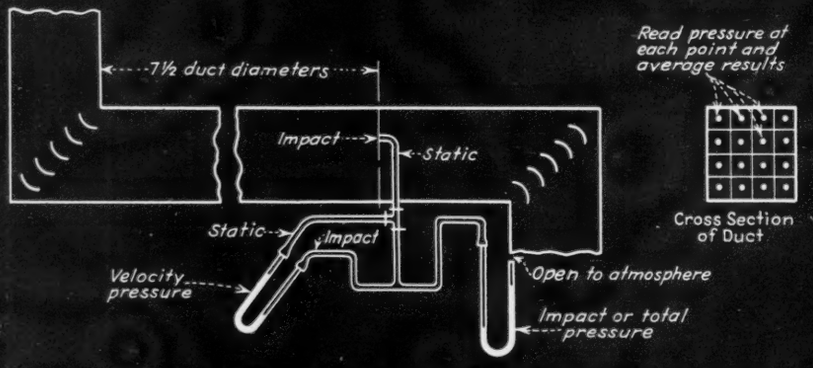


Fig. 11—Impact and velocity pressure-measuring arrangement for traverse in gas duct. Average of pressure readings is sufficiently accurate for field test

with consequent improvement in combustion efficiency at high ratings.

Natural-draft systems have relatively small available pressure difference compared to mechanical-draft installations. Consequently an improvement in duct arrangement yields proportionately greater return. Old chimneys are likely to have time-roughened linings and leaky breechings. A new stack lining that presents a smooth surface requires no strategic-metal priorities. For the effect of increasing stack height, see POWER, April 1941, page 114.

Infiltration of air to furnace or breeching exerts much more influence on draft-system capacity than is usually supposed. As much as 15-20% is not uncommon, even in well-kept plants. Convincing evidence of the size and location of cracks can be quickly obtained by partly closing the uptake damper nearest the stack to create a pressure in the furnace. A more refined procedure calls for a titanium-tetrachloride smoke bomb (sky-writing smoke) within the furnace, with forced-draft fan in operation and uptake damper tightly closed. Remember that an opening near the induced-draft-fan inlet box is under high suction and will pass many times the amount of cold air that will flow through the same size passage into the lower part of the furnace where only a slight suction is maintained.

Another quick check on leakage of duct and breeching between economizer or boiler outlet and stack opening can be accomplished with only a thermocouple or thermometer. Percent infiltration is almost directly proportional to temperature drop.

These expedients are listed here so that they will not be overlooked in a check-up of the draft system. They are all within the control of the operator and entail no appreciable cost. Only after the operator has assured himself that his own house is in order should he consider the greater cost (and materials) necessary to increase the size or output of the fans themselves, for which he must call in the manufacturer.

A given fan can handle more volume if the wheel is speeded up. Volume increase is about proportional to speed increase. Fan wheel stresses increase greatly when the fan is driven faster and it is essential to check with the manufacturer on the maximum safe speed for a given design.

Turbine-driven fans can sometimes gain a few rpm by an increase in steam pressure. However, a 10% increase in steam pressure will yield only about 3% increase in weight of gas handled.

Increasing speed by utilizing a new motor of the next higher synchronous rpm requires that the new drive have much more rated hp than the replaced unit. A 10% higher speed requires a 30% larger motor.

Rebuilding Fan Wheel

Rebuilding the fan wheel offers the possibility of increased pressure and volume at the same speed or at higher than the original speed. In either event wheel construction must be heavier. Rebuilding or refloating the wheel usually requires new drive equipment but only minor changes to casing and ductwork.

In general, it is quicker and cheaper to overcome a draft-limitation problem by improving the flow path of the air and gas streams than by rebuilding the fan. The amount of plate and welding required represents only a small part of the cost of new boiler capacity. The improvement gained not only increases capacity but accomplishes that result through an actual increase in draft-system efficiency which will continue to pay dividends in fan-power savings over a period of years.

Most boiler manufacturers now check duct drawings to assure good flow conditions. Fan manufacturers in their turn make every effort to point out conditions at induced-draft fan inlets that may reduce the capacity or efficiency of the fan. For any installation more than a few years old, however, there is practical evidence from scores of cases that streamlining flow is a simple and worthwhile solution to most draft-limitation problems.

Cooling Diesel Jacket Water

Successful operation of a cooling system hinges on selection of adequate and economical means of heat disposal. Glenn C Boyer, Burns & McDonnell Engrg Co, gives useful pointers on radiators, ponds, cooling towers and evaporative coolers

▶ AFTER THE OUTLET TEMPERATURE and desired temperature rise have been determined and the amount of heat to be recovered from the jackets is known, it is necessary to decide how to dispose of the heat. Where large quantities of water are available (rivers, lakes, wells), the heat can be literally "dumped" and no equipment except piping and pumps is required. Similar simple arrangements can be worked out in water-pumping plants, where the raw water can be used for cooling, and in pipeline pumping plants where heat can be absorbed in the oil or gasoline being pumped.

Where water is limited or costly, other means of heat disposal must be used. These transfer the heat to the surrounding atmosphere but employ different methods: (1) *radiators* give up the heat by convection, raising the temperature of the passing air stream, and (2) *spray ponds, cooling towers,* and *evaporative coolers* depend on the cooling effect of the evaporation of small quantities of water.

Radiator cooling is extremely simple. Because the cooling takes place in closed tubing, with no contact between air and water, a single circuit (jacket to radiator and return) becomes equivalent to a double circuit with most other cooling methods. These units depend entirely on raising the temperature of the air passing over the tubes. Because air's specific heat is relatively low (0.01812 Btu per cu ft per F) large quantities of air must be circulated if extensive cooling is required. For example, a 1000-hp engine, with air passing the radiator at 70 F and with water temperature averaging 120 F in the radiator, would require 120,000 cfm for adequate cooling.

Evaporative cooling methods depend for their effectiveness on the fact that the conversion of one pound of water to one pound of vapor, at atmospheric pressure and temperature, requires approximately 1000 Btu. The transfer of heat from water to air, necessary for evaporation, can take place only when the water temperature is above the wet-bulb temperature of the air. Thus the temperature to which water can be cooled in any evaporative cooling device is limited by the wet-bulb temperature existing at the time.

While the wet-bulb temperature is the lowest limit to which water can be cooled by evaporation, this temperature is only *approached*, never realized in practice. How close the wet-bulb temperature is approached depends on the design of the equipment and more particularly on the economics of the situation. It is usually found most economical to design mechanical-draft cooling towers to cool water to within about 10 F of the wet-bulb temperature; spray or deck towers are usually designed for about 15-F difference. Water in a spray pond can be cooled economically to within about 16-18 F of wet-bulb temperature.

Thus selection of evaporative-cooling equipment for a given plant requires a knowledge of wet-bulb temperatures experienced in that locality. Analysis of summer weather conditions (when the wet-bulb temperature is high) has lead to the development of a map carrying lines of constant wet-bulb temperature, much like a contour map (see POWER Data Sheet No. 114, pg 128, this issue). The lines represent what might be called "design maximum wet-bulb temperatures" that will be exceeded for not more than 5% of the total hours during June to September, inclusive, in a normal summer. Thus, if the map shows a maximum wet-bulb for Evansville, Ind., of 78 F, then, to all intents and purposes, a mechanical-draft cooling tower will cool water to 88 F, or cooler when the wet-bulb is less than the maximum indicated. Experience indicates that evaporative cooling installations based on the data from this map give satisfactory results without requiring excessive investment.

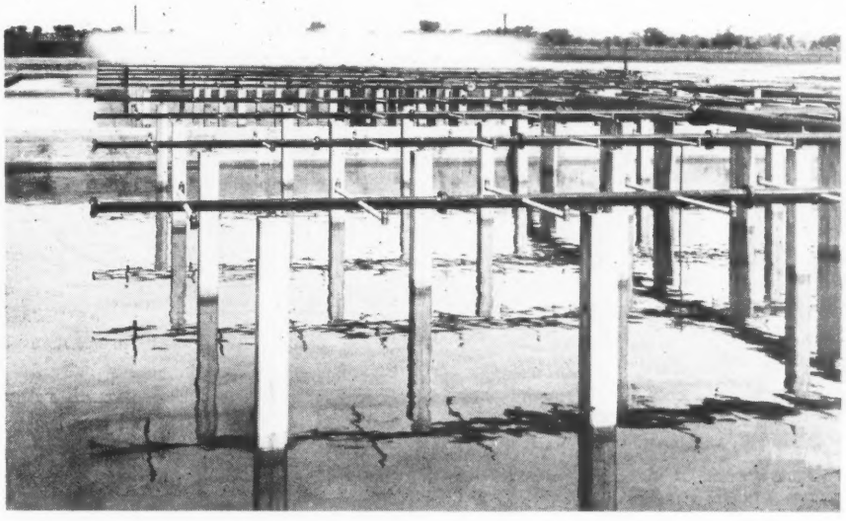


Fig. 1—Large spray pond with one section in operation

Of the various evaporative cooling devices, *surface cooling ponds* are simplest, requiring no mechanical equipment aside from a suction and discharge well. With only the surface exposed to the air, the cooling efficiency is extremely low and large area is required if a reasonably close approach to wet-bulb temperature is to be made. Possibility of sudden water loss, earthing-in of the basin, and the great amount of heat absorbed from

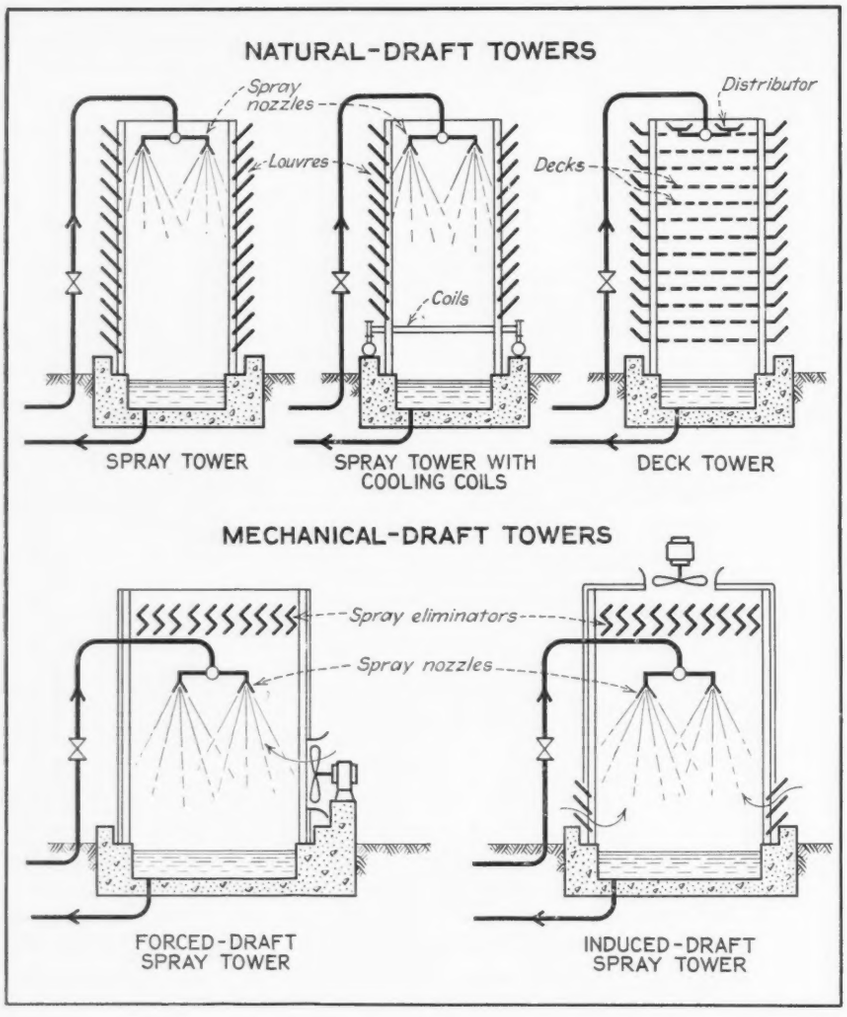


Fig. 2—Cooling-tower types, both natural and forced draft

the sun limit the usefulness of this method. Algae growth, icing, and building-up of concentrates are other features difficult or costly to control. On the other hand, low pumping head and absence of drift losses are desirable features.

Spray ponds consist essentially of a group of spray nozzles supported above a pond or basin; the sprays bring more water into contact with the air and so increase cooling efficiency. There is a wide difference between the extremely small and the extremely large pond. The smaller pond is capable of somewhat better cooling and has a lower first cost, but shows a greater drift loss on a gpm-area basis. In comparing spray ponds with other methods, the characteristics of a pond of average size are usually considered.

In spray ponds of practical design, cooling efficiency falls off rapidly with decrease in wind velocity or adverse wind direction. Drift loss, as well as ground area required, are comparatively large for the ordinary spray pond, although drift loss can be minimized by an effective louvre fence around the pond. This, however, adds materially to the cost. Pumping head is more than for a surface pond but still is comparatively low.

Spray towers are in effect small spray ponds closely surrounded by a louvre fence. The spray system, however, is usually located at the top of the tower and is directed downward in most cases. Induction of air caused by the pressure of the falling spray water in the tower helps during periods of wind stagnation or adverse direction. Lack of sensitivity to wind velocity and direction makes tower cooling efficiency better than that of ponds. Effective louvred sides keep drift loss to a small percentage and the low height of the tower keeps the fine mist that escapes from traveling far.

Reasonably low pumping head, simplicity of design, ease of operation, and low maintenance are desirable features of the spray tower. Original cost for small spray towers is exceptionally low, but increases with size to the point where a unit having a capacity of 1600 gpm or more is not always economical. Large towers are long because they must be kept narrow to make efficient use of the breeze through the tower.

If any of the foregoing evaporative cooling methods are to be used in a double- or closed-circuit cooling system, the water must be pumped through a heat exchanger in which the jacket water flows. Putting coils in the base of a spray tower, over which the spray water falls and in which the jacket water flows, forms a convenient double-circuit arrangement. Such units are called *spray-coil towers;* however, the use of heat-exchanger tubes in the tower base is widely applied in all types of towers.

Deck towers depend for their cooling effect on water falling through a series of staggered trays or wood deflecting plates. They can be designed for high efficiency but it can be maintained only provided that wind of appreciable velocity and from the proper direction is present. Cooling efficiency of this type of equipment drops rapidly as wind velocity falls. This sensitivity arises from the need for air movement across the horizontal decks. Air movement by induction or convection is not rapid enough to be effective during periods of calm.

Drift loss is small in comparison to that experienced with the spray pond and is less than for spray towers. This loss increases as wind velocity increases but not always in direct proportion. The design of the louvred sides represents a compromise between

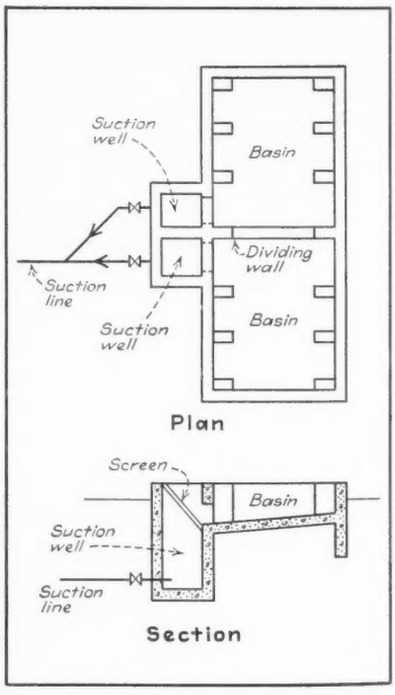


Fig. 3—Details of basin divided so that one half can be taken out of service for cleaning without interfering with cooling-system operation

providing free passage of air and holding to a minimum the amount of water which escapes at high wind velocities. Required pumping head varies with tower height and is on the average greater than for other types of cooling equipment. Like spray towers, deck units must be built long and narrow. First cost gradually decreases from a relatively high figure for smaller sizes to moderate figures for towers of 1000 gpm capacity, or more.

Mechanical-Draft Towers

Mechanical-draft towers employ fans to create the necessary wind. They can be designed for high cooling efficiency under all conditions because the efficiency is entirely independent of wind velocities and direction. Units with fans at the base, blowing air upward through the tower, are called *forced-draft towers; induced-draft towers* have the fan at the top, sucking air up through the unit. Drift loss is almost negligible; ground-area requirements are small in comparison with ponds or deck towers. Pumping head is somewhat higher than average but not as great as for deck towers. First cost, based upon comparative performance during all wind conditions, is low, particularly for the larger installations. Savings resulting from higher average efficiencies usually offset fan power costs.

In purchasing a mechanical-draft tower it is advisable to have at least two fans installed as insurance against the possibility of fan or motor failure.

Basins for either spray ponds or cooling towers deserve considerable study, especially from the maintenance standpoint. An examination of many basins indicates a gradual accumulation of dirt and rubbish, regardless of the care which is exercised by the plant operating staff. This foreign material collects on or near the intake to the cooling-system pump suction, occasionally stopping water flow. Also, dirt blown into the basin leads to considerable difficulty with clogging of pumps, valves, fittings and strainers.

Because of these conditions, Burns & McDonnell designs provide a divided basin for each cooling tower or spray pond, arranged so that one half of the basin can be taken out of service, cleaned and put back into operation during low-load periods when the demand for cooling is not up to the maximum tower capacity. In this way it is possible to clean the entire basin while keeping cooling service up to station requirements. A typical construction for such a basin, Fig. 3, has a floor sloping toward the suction well so that dirt and rubbish will collect in the lower portions where it can be cleaned out more readily. Each half of the basin has an intake screen arranged to protect the entire suction well from falling leaves and other debris. Sloping the screens makes cleaning easier.

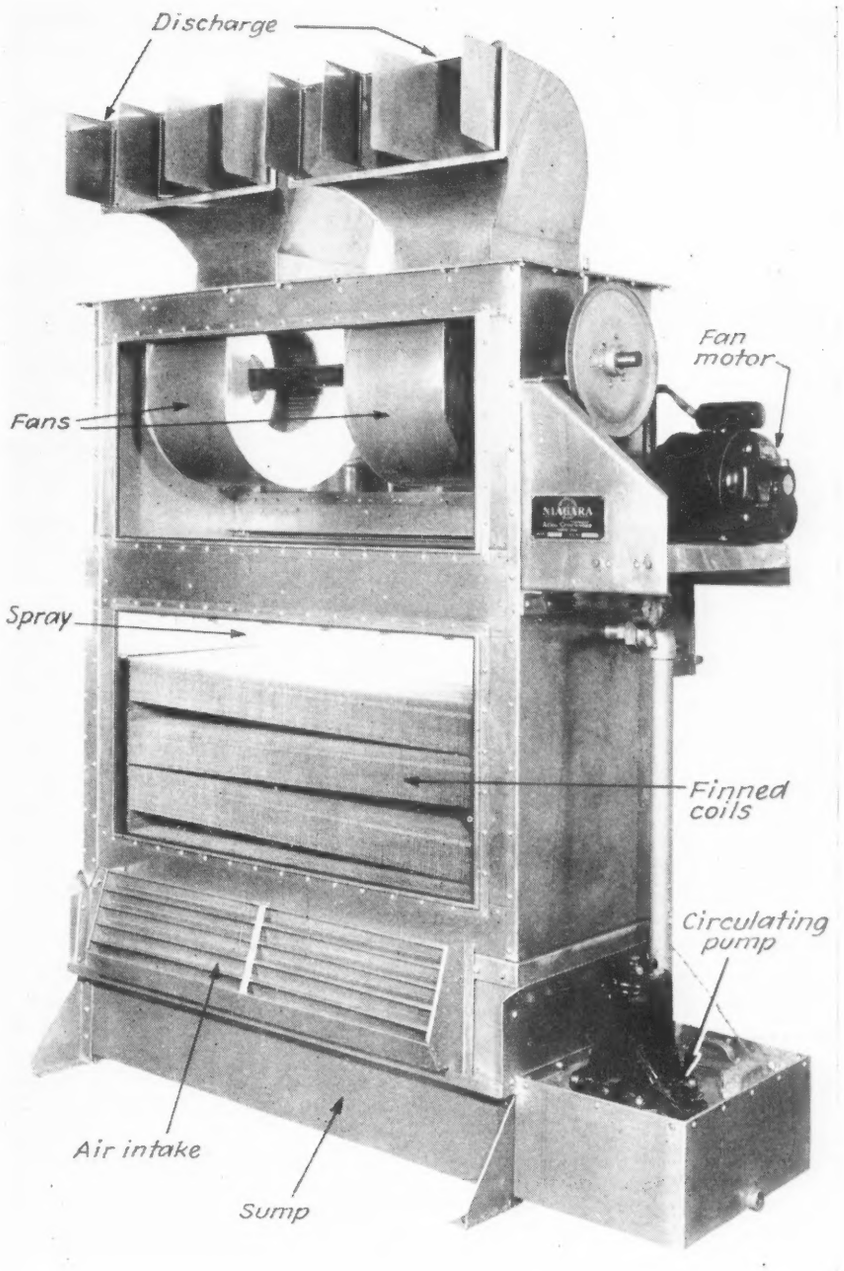


Fig. 4—Demonstration model of evaporative cooler showing construction details

Evaporative coolers, known as evaporative condensers, have had wide use in the air-conditioning and refrigerating fields; their numerous advantages are also making a place for them in the diesel field. Basically, an evaporative condenser is a cooling tower with a heat-exchanger coil in the base. The evaporative cooler is distinguished by its compact "packaged" design and suitability for indoor use. Jacket water flows through a finned coil, the outside of which is under a spray supplied by a small centrifugal pump which recirculates water from the supply tank in the cooler bottom. A fan forces a relatively large volume of air through the unit. Makeup water (about one gpm per 500,000 Btu dissipated per hr) enters the supply tank under float-valve control.

These units are usually installed inside the power plant or engine room. Provision should be made to take required circulating air from both outside and inside the plant. During summer months, taking air from inside will furnish ventilation; outside air will produce maximum cooling. If air temperature falls below 35 F, tempering with inside air will prevent freezing.

Governing Turbine Pressures—I

Speed- and load-control equipment of modern turbines must do much more than maintain frequency. Raymond Sheppard of General Electric Co discusses governor requirements of superposed turbines and multi-pressure systems

► CLOSE REGULATION of system frequency requires that a predominance of generating capacity be controlled by speed-sensitive governors. Automatic frequency control is usually applied in the form of relatively slow supplementary adjustments. The normal action of the basic speed governor, however, is still the backbone of system speed control.

The progress of superposed turbines with their automatically controlled unit boilers has presented some new fundamental governing problems. More satisfactory station performance appears to result if some of the turbines are governed (at least during periods of disturbance) with one or another form of steam-pressure control.

In general, supplementary pressure controls are employed primarily to aid reestablishment of stable conditions within the station immediately following abnormal disturbances to either the boilers or prime movers. Experience and theory to date have produced no obstacles to the continued development of pressure control for superposed or condensing turbines.

In the familiar arrangement of low-pressure boilers in battery each feeds steam to a common header supplying one or more turbines. Failure of one boiler is not of serious concern, even though the fault occurs suddenly, since much storage capacity exists in the many other boiler drums. Further, the remaining boilers, by virtue of their number, are quite well able to steam along without interruption of supply to either prime movers or station auxiliaries until something can be done about the disabled unit.

The trend in plant additions, however, is universally toward a single boiler per turbine with no interconnections to adjacent units. A variation of the same plan employs two boilers to supply one large turbine. In either case, storage capacity of the high-pressure boiler or boilers is much smaller than that of older low-pressure stations, and sudden loss of part of the steam flow results in serious pressure drop for the whole unit, unless the steam valves of the turbine are promptly closed sufficiently to compensate for the reduced steaming rate. This characteristic of the high-pressure boiler plant, losing pressure rapidly, requires use of additional protective devices. These automatically take control of the turbine steam valves in the event of a sudden reduction in ability of the boiler to produce steam at the rate for which the control valves were previously set by the speed or backpressure governor.

The speed governor has the advantage of greatest simplicity. With its manual load adjustment in the hands of the electrical operator, it has been for years entirely satisfactory for controlling steam turbines. It will undoubtedly continue as the sole controlling element for new high-pressure condensing turbines where a sufficient number of interconnected boilers are installed. If, however, only one or two boilers supply a condensing turbine, it may be desirable to equip the unit with a supplementary "initial-pressure" regulator which acts as a limit governor.

Too-rapid loss of pressure may damage a turbine or boiler by (1) carrying water into the turbine or (2) introducing high thermal stresses near the inner surfaces of thick boiler drums.* Initial-pressure regulators actuated by changes in boiler pressure were devel-

* *Results of studies and experience with high-pressure boiler drums by American Gas & Electric Co*

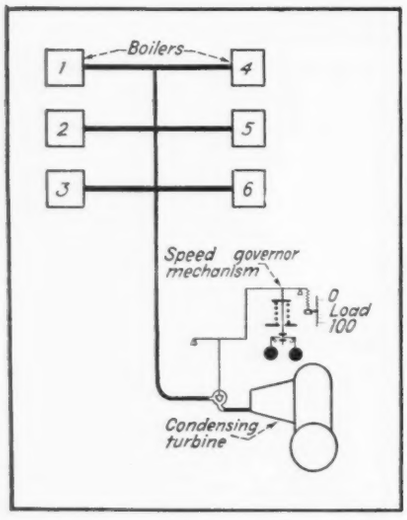


Fig. 1—For a condensing turbine supplied by a group of boilers, simple speed governing is adequate and reliable. Black flyballs indicate that speed governor is in command of the turbine

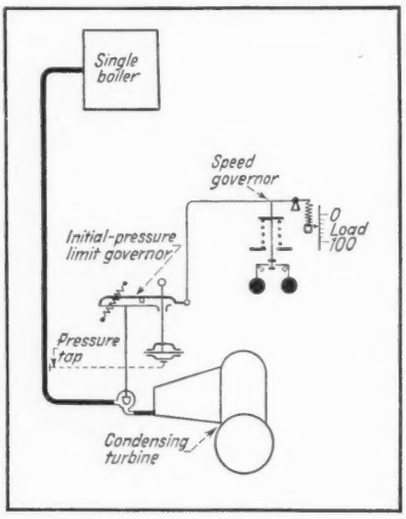


Fig. 2—If a single boiler supplies a turbine, speed governor is supplemented by an "initial-pressure" limiting device that restricts control-valve opening if steam pressure falls below set limit

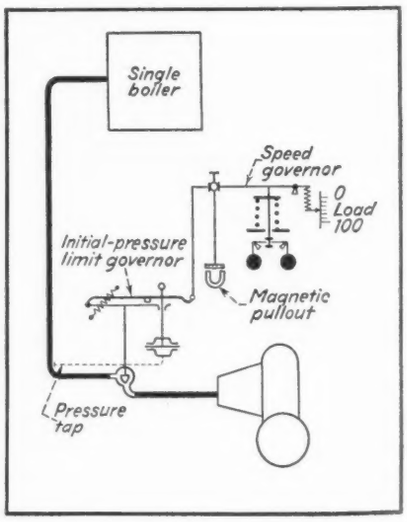


Fig. 3—Standby steam units for hydro systems should hold constant light load even with frequency variations of one-half cycle. Magnetic pullout holds unless frequency change is large

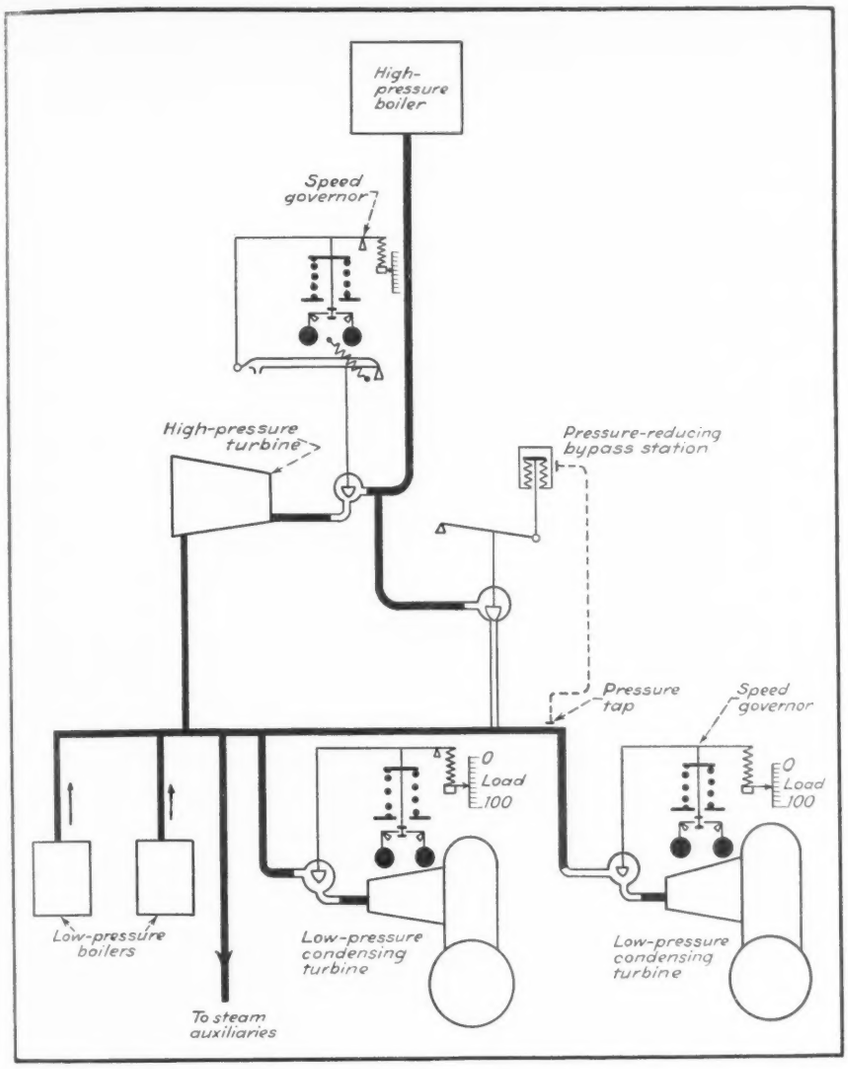


Fig. 4—If low-pressure boilers are continued in service after superposed unit is installed, load on station units can be regulated satisfactorily with synchronizing motors

oped to avoid these troubles by closing down on the turbine control valves to reduce steam demand.

This device has additional service features if used with certain combinations of station controls. For example, the initial-pressure limit governor,† in conjunction with a speed governor controlling the low-pressure turbine of a superposed plant, will protect against loss of low-pressure header steam that may be vital for auxiliary supply. Loss of steam-generating ability of this nature can be caused by sudden stoppage of a pulverizer or coal-feeding equipment or any number of similar contingencies.

The function of the initial-pressure limit governor is supplementary to usual speed governing, illustrated in Fig. 1. Here a condensing turbine is supplied by a group of interconnected boilers. Nothing more than the extreme simplicity of the speed-governor control and the reliability afforded by the several boilers is required. The speed governor is in control of the turbine steam valves (indicated in the diagram by coloring the flyballs black).

A condensing turbine fed by a single boiler, Fig. 2, is also normally speed governed. The initial-pressure limit governor is normally inactive. Only in case of sudden inability of the boiler to continue its required steaming rate does the initial-pressure limit governor act to restrict the control valves. The speed governor, with its load adjustment set by the operator, has full control of the turbine so long as the boiler pressure is kept within practical limits by the combustion-control system.

If the boiler pressure drops to some arbitrary level, 10% below normal, for example, the limit governor comes into service to position the steam valves and check any further decline. The electrical output will be proportional to whatever steam flow the boiler plant can produce in its semi-disabled condition. Any attempt to hold original generator load will pull boiler pressure down to a point where output is within heat-generating capacity of the boiler plant.

With the initial-pressure limit governor in control, the electrical operator can recover switchboard control at any time by changing his load setting to what the boiler can carry. The pressure will rise to normal and the initial-pressure regulator will back off to its out-of-action position. If the boiler fault is short lived, the turbine will automatically resume its original load as the boiler room recovers its steaming rate, provided load adjustment has not been changed in the electrical control room.

The governing arrangement, Fig. 2, is also applicable to industrial plants producing power from waste-heat boilers with generators paralleled with utility lines. All available waste fuel is burned, with the result that the turbine output automatically changes with burning rate. Operation is accomplished at substantially constant boiler pressure. The inactive speed governor in this case functions as a pre-emergency overspeed protection that can take over control of the turbine should the generator become separated from the system.

In Fig. 2 and following diagrams the usual power oil relays are omitted for simplicity. Also, the various controlling devices are shown linked to the elementary steam valve by a *split lever*. The upper and lower halves of this lever are understood to be *biased*, that is, held together by a spring.

Another device, the magnetic pullout,** Fig. 3, holds the speed governor anchored so that small frequency variations do not open or close the turbine valves and cause fluctuations in steam pressure and variations in load. Standby steam units for hydro systems run at as light loads as possible, and normal variations in frequency up to plus-or-minus half a cycle give considerable difficulty to the boiler room.

With the magnetic pullout, the turbine steam valves remain in fixed positions at whatever arbitrary load the operator has assigned the unit. A frequency drop of more than one-half cycle causes the speed governor to build up enough force to pull away from the magnet and thereafter the load on the unit becomes a function of the system speed.

Because the moment of such occur-

† *The first initial-pressure limit governor built by the General Electric Co was installed on a 60,000-kw superposed turbine for the American Gas & Electric Co. Additional ones have been ordered for several types of high-pressure condensing turbines*

** *The magnetic pullout device was originally designed by F G Philo of the Southern California Edison Co. It has been widely applied in steam plants of that company and those of the Pacific Gas & Electric Co*

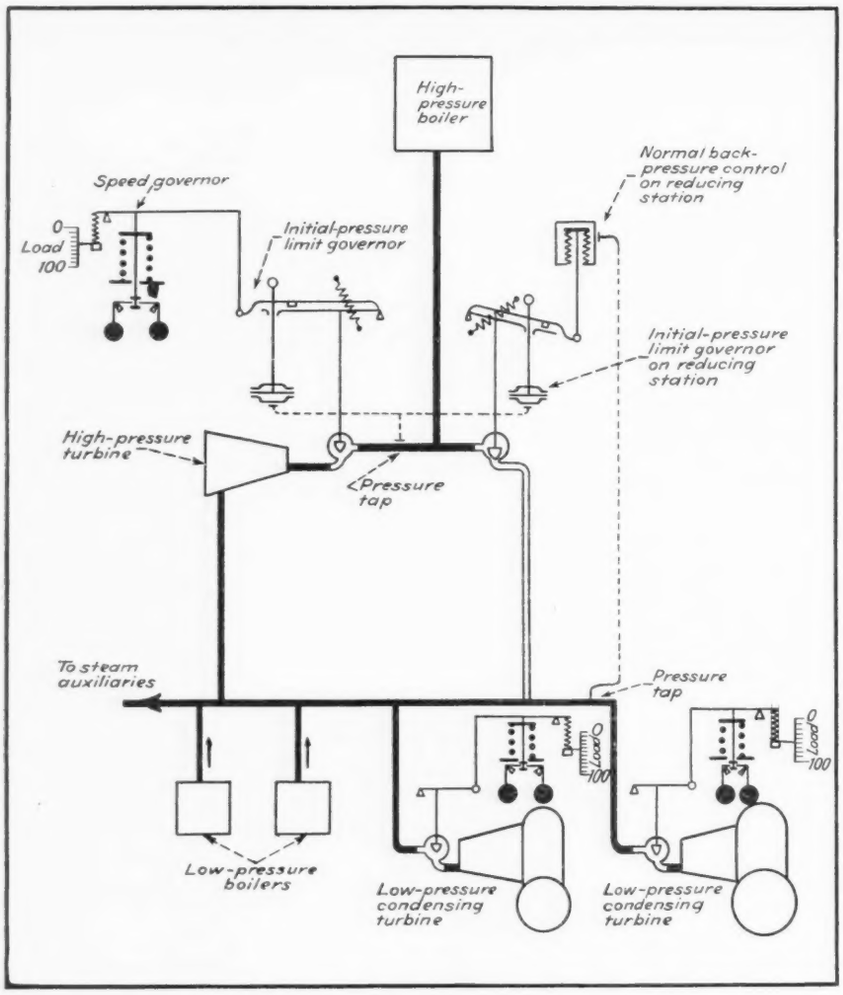


Fig. 5—Addition of "initial-pressure" limiting governors to superposed plant eliminates need for manual adjustment in event of high-pressure-boiler failure

rence is unpredictable and finds the boiler unprepared for sudden increase in demand, pressure falls rapidly. When pressure has fallen perhaps 10%, enough to put the boiler combustion control in high gear, the initial-pressure limit governor steps in and halts further decline by restricting the control-valve opening demanded by the speed governor because of the low frequency.

As fast as the boiler can pick up load the initial-pressure limit governor will automatically reopen the turbine control valves. Control of the turbine is handed back to the speed governor without any manual attention as soon as frequency returns to normal.

The reasoning behind this control scheme is that it is useless to take steam out of a boiler any faster than heat can be put in the water. From the reliability standpoint, however, standby stations should pick up load as fast as conditions will permit. The latter is accomplished automatically with the governing system of Fig. 3.

Another scheme, Fig. 4, suits superposed plants where low-pressure boilers remain in service. The latter serve to keep steady pressure on the low-pressure header. Electrical load can be distributed arbitrarily between high- and low-pressure turbines by adjusting speed-governor synchronizing motors.

If the electrical network being supplied by the station is large the frequency is generally quite steady, hence the high-pressure turbine and boilers can be utilized at uniform high capacity for best station economy. Changes in load ordered by the dispatcher usually proceed slowly so that manual operation of the low-pressure turbine speed governors can be compensated for by the low-pressure-boiler operators.

In case of accidental opening of the high-pressure generator switch uninterrupted flow of steam from the high-pressure boiler, Fig. 4, is assured through the bypass valve. The latter opens automatically on indication of abnormal pressure with scarcely more than a momentary pressure dip.

Sudden loss of load on one of the low-pressure turbines requires prompt reduction in firing rate of the low-pressure boilers to avoid blowing safety valves. The high-pressure turbine and boiler will continue undisturbed at their previous rating unless manual adjustment of the governor is made by the operator. While a backpressure governor is usually furnished with a superposed unit, its use is seldom required as long as low-pressure boilers remain in service, except as a pressure-limiting device for the low-pressure header.

Sudden inability of the high-pressure boiler to continue its steaming rate causes initial pressure to fall rapidly unless the steam-valve opening on the high-pressure turbine is promptly reduced. Plant operators have established routine practices to meet this contingency in one of two ways. If the electrical control room is in the same building, a steam-pressure gage enables the electrical operator to observe a drop in pressure in event of boiler-room trouble. Any decrease below an agreed arbitrary value can be checked by the electrical operator by reducing load on the high-pressure turbine.

If a gage in the control room is impractical, turbine operators can reduce load by means of the mechanical limit device. Either of these manual methods are effective but require that operators keep an alert eye on pressure at all times. There are, however, a number of superposed plants operating with the scheme, Fig. 4, so that ample operating experience has been accumulated to testify that practical station operation can be gained without additional controls.

The addition of initial-pressure limit governors removes dependence on the human element. Two such supplementary controls, one on the high-pressure turbine and one on the pressure-reducing station, Fig. 5, obviate the necessity of any manual adjustment in event of interruption of the steaming rate of the high-pressure boiler.

One initial-pressure limit governor on the turbine is not sufficient, as the backpressure element on the reducing valve also attempts to open and maintain constant header pressure. Any unintentional reduction in flow through the superposed turbine calls for an increased flow through the reducing station so that it, too, must be prevented from drawing down boiler pressure. The ability of the reducing station to open promptly in event of trip-out of the high-pressure generator is in no way handicapped by its initial-pressure limit governor, as such accidental loss of the high-pressure turbine results in a rise of boiler pressure. With boiler pressure normal or higher, the limit governor on the reducing station is held out of action.

Editors Note: *A second article by Mr Sheppard, covering more complex superposition arrangements, will appear in March* POWER

How to Get Rid of That Troublesome Air Pocket

Principles of trap operation make them suitable for many duties. S H Coleman describes their use for venting air or gas from liquids under pressure in containers

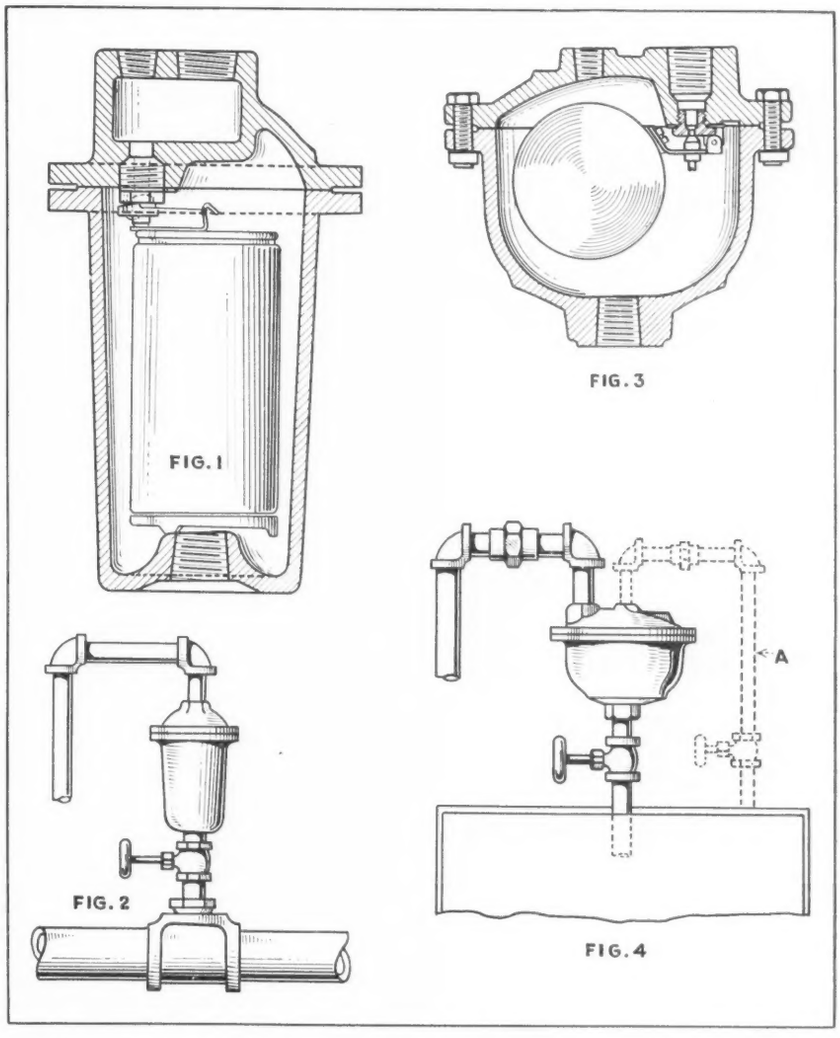
▶ THE PRESENCE OF GAS in a closed vessel reduces its capacity to hold liquid and may be responsible for accelerated internal corrosion. Extraneous gases in pipelines lower capacity, increase pumping difficulties, and contribute to water hammer. These difficulties can be avoided by venting all spaces, such as high points in pipelines where gases may accumulate, with the proper trap and piping arrangement. If correctly installed these traps will insure the prompt and efficient removal of any trapped air and will eliminate the uncertainties of the human factor that, along with the possibility of waste, can always be expected when venting must be done manually.

Where a considerable volume must be vented, the inverted-bucket trap, Fig. 1, having a closed bucket vent can be used satisfactorily if installed as shown in the piping diagram, Fig. 2. As the water level rises in the empty trap, air or gas under the bucket causes it to float and close the valve. Any additional gas entering the trap fills the bucket and then begins to escape under its rim. Rising to the top of the trap chamber this excess gas causes the water level to fall until the bucket loses its buoyancy and sinks. When the bucket drops, trap valve is opened and the gases are vented.

An inverted-bucket trap has a number of advantages when used in this service. Principal among these is its intermittent functioning, insuring positive opening and closing of the discharge valve, an action that prevents dirt from lodging between seat and valve to cause leakage. When using inverted-bucket traps for this purpose the vent hole in the top of bucket must be sealed.

Ball-float air traps, Fig. 3, can be used to vent air or other gases from any liquid under pressure provided pressure limits imposed by strength of the trap body and resistance of the float to collapse are not exceeded. When installed as shown in Fig. 4, the trap body is normally filled with liquid so that the ball floats and holds the valve closed. Gas entering the trap body causes the water level to drop, allowing the float to sink and open the valve. If very little gas is to be vented, a single pipe connection between the vented space and the trap is sufficient to handle both gas bubbles and liquid. Where large volumes of gas must be handled, a 2-pipe connection is desirable. With the trap connected in this manner the gas enters the trap body through the pipeline *A* shown with the dotted line, while liquid enters and leaves though an extension of the bottom connection also denoted by dotted lines. Using this method there is little or no interference of gas with liquid or liquid with gas in either line.

Operators using the ball-float trap for venting must take precautions against the danger of dirt or particles of scale lodging between valve and seat when the valve is only partly open. If this happens the valve may be prevented from seating and leakage will result.



Figs. 1, 2—The trap must be connected in the top of the vessel or pipe line. Figs. 3, 4—The double pipe attachment reduces interference to the flow of liquid air

. . . I fell out of the lady's good graces . . .

THE OLD CHIEF

XV—Mrs Chief Speaks Her Mind

Fifteenth in a series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the inspiration of the past, he has captured much of the human side of engineering that lies beneath the maze of power-plant costs and the wavy lines on paper disks

▶I SUSPECT that all busy executives have some kind of secret code, by which their assistants can extricate them from long-winded callers. I do know that I had just such an understanding with the Old Chief, which permitted me to run interference for him on many occasions. If I told him in front of strangers that Mr Percy Pocock would like to speak to him in the manager's office, he would immediately understand that it was time for him to go home or that I wanted him free for some reason or another. Our manager's name was Pocock all right but his initials were A J and not Percy. The change in the Christian name was our code, and it worked well.

The Old Chief had, for reasons best known to himself, forbidden his wife to call him by phone during business hours. However, this did not deter the good lady from calling me up to make sure that he did not forget his rubbers or to tell me that she was sending his raincoat over. On occasions I would be asked over the phone, "What ever in the world is keeping that fool man in that smelly old power house, when his lunch is on the table waiting for him?" She would add that she knew he just did it to provoke her and that she was not at all sure but that I had something to do with it. I often thought that if there was anything in the adage which says that opposites are happy in marriage, then the Old Chief must have been a very happy man, because his wife was as austere as he was genial, as thin as he was stout and as high strung as he was easy going.

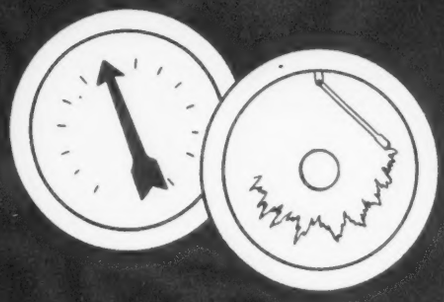
Unfortunately, I fell out of the lady's good graces when I had to refuse to endorse two of her nominees for jobs in the plant. It happened about the time of the first post-war depression, 1921-22. Those who recall those days will remember that openings for young men were few and far between and lobbying was only exceeded by the type we experienced in the big depression that followed ten years afterwards. Just prior to stocktaking the Old Chief decided to start two apprentices in the power house. We received 27 applications and much to my surprise the Old Chief gave me the job of interviewing the applicants.

Undue Influence

I found out why I had been elected when I received a call from the Old Chief's wife to the effect that her cousin's boy and the son of her dearest neighbor were applying and that they were the very nicest boys in town. Fortunately the medical examination took care of the relative, together with a dozen or so of the others, but the other nominee ran in fourth place on my rating. I gave each of them proportional credits for education, physique, experience and personality and handed in my report.

I am happy to reflect that our two first apprentices became in time department heads. But never again did I regain the friendship of Mrs Chief for, as she stated, "Giving preference to a couple of nobodys who in all probability had never seen the inside of a Sunday School." About a year afterwards, when the question of apprentices was again to the fore, the manager asked me why I apportioned such high credits to education, in view of the fact that most engineers in the plant, including the Old Chief and myself, were without secondary education.

I gave as my reason the belief that while an academic education might not be of major importance to an engineering apprentice, nevertheless his success along those lines represented to me, documentary evidence of the young man's *ability to learn*. In the years that followed the Old Chief steered many of these boys over the hard places. He would laugh at their brashness and their timidity and was never slow to reward them with a word of praise or a little soft-spoken advice. Some fell by the wayside, because of the boiler room's grime and dirt, some rebelled at the long hours and adopted salesmanship or some other dubious means of livelihood. But I will say this for "Joe College" and his brother "John High School": on the average, they were, our records show, easier to get along with, more ambitious, more adaptable and just as willing to work hard as the fellows whose education had not been quite so broad.



METERING FLOW

By F. A. ANNETT
Associate Editor

TO PRODUCE MORE from less is the object of every normal industrial operation. For that purpose the good business manager keeps detailed records of output and consumption. He watches the output to keep it high—and all the consumables to keep them low.

The power plant is no exception. Coming in are the cost items—fuel, water, labor, repairs, and so on. Going out are the steam, electricity, compressed air and other "pay" items. The whole art of power operation can be boiled down in this: "Keep the input low in relation to the output". To attain this ideal every major element of input and output must be constantly measured and studied.

Sometimes the measurement is mere counting, as with wage dollars. Sometimes it may be the weighing of batches, as with coal. More often a flowmeter is the only way to get the answer—certainly so for the fluid services. One requires meter records or readings for the feedwater input of the boiler, for the steam output of the boiler and the steam input of the turbine, for service water pumped and service air compressed, for refrigeration produced, and so on.

No engineer can make out his daily, weekly or monthly "score card" of plant performance without flowmeter records. But that's not all: the meters do far more than keep score. They show the operator how to make a good score by instant warning when plant-operating conditions get out of balance, before real damage has been done.

So much for savings in generation. Even more important in many cases are the savings flowmeters can make in the industrial distribution and application of the power services. In the factory department, as truly as in the home, a monthly service charge, based on actual metered use, cuts down consumption amazingly. That is why good industrial management calls for the separate metering of every major consuming department.

These dollar savings in generation and application would be the normal peacetime justification for this special section (POWER's 39th) on the subject of flow measurement. *In addition flowmeters have a special wartime value appropriate to the present grave national emergency: they are "capacity producers" as well as dollar savers.*

Every time a flowmeter reduces consumption of an essential power service that reduction is exactly equivalent to a corresponding enlargement of the generating plant. Steam saved equals more boiler; water saved equals a bigger pump; air saved takes the place of more compressor capacity; power saved is the equivalent of more power-generating capacity and so on. This important fact dovetails with a situation in which war production is imperiled in many factories by the overloading of industrial power equipment, by inadequate reserves, by inability to get deliveries on new units or even spare parts.

The reader will appreciate the impossibility of "covering" flowmeters in these twenty pages, or even in a hundred. All that could be attempted here was a broad outline of flowmetering devices, their principles of design, operation and application. Because space did not permit describing all makes of meters, units were selected at random to illustrate certain points. These selections do not imply any preference for one product over another. Nor are any preferences implied in the comparison of design features.

The section sketches the principle of metering in clear and concise form, but avoids all abstract theory as not worthwhile for the average reader. To those who wish to dig deeper we recommend the flowmetering publications of the ASME. The excellent literature of the flowmeter manufacturers will be interesting reading to those who want to know more about the various designs.

Primary Elements

▶ OF THE SEVERAL CLASSES of meters for measuring flow of liquids, steam and gases, those known as head meters are most generally used. Head meters derive their name from the use of a device in the stream of fluid that creates a difference of pressure, or a differential head which depends upon the velocity and density of the liquid.

These meters consist of three essential units:

1. A differential-pressure device, frequently called the primary element, in contact with the fluid to be measured.

2. The meter body, or metering device, that measures the differential pressure created by (1).

3. The indicating and recording devices that show and chart the rate of flow per hour at any instant, and the integrating device that records the total flow in cubic feet or pounds. These units may be built separately or combined into a single unit, with or separate from the meter body.

The meter body in combination with the indicator, recorder or integrator, is frequently referred to as the secondary element. Only differential-pressure devices will be considered in this article.

Differential Pressure

A primary element is placed in a liquid or gas line to create a differential pressure which will serve as a measure of the flow rate. For closed pipes the element may be a thin-plate orifice, a flow nozzle, a pitot tube, a venturi tube or a modification of one of them.

If a disk orifice is placed in a pipe line, Fig. 3, and pressure measurements made above the pipe when fluid is flowing, a pressure variation will be found similar to that indicated by the solid lines. This occurs because of a change in fluid velocity.

What we see in Fig. 3 resembles the action we get from a garden hose. At the nozzle inside the hose static pressure may be 50 lb per sq in. If there is a little hole in the hose the water shoots out at right angles to it. However, when the water passes through the nozzle something happens. It no longer flows at right angles to the hose but in a smooth stream directly away from the nozzle. The static pressure or head inside the hose is converted into what is called velocity head when the water passes through the nozzle. When the water reaches the discharge end, practically all the static pressure has been converted into velocity head to drive the water through the atmosphere.

When the hose discharges into the atmosphere the stream keeps going until air friction breaks it up and gravity pulls it to the ground. When a fluid flows through an orifice in a pipe line, it accelerates, and part of the static pressure turns into velocity head, producing a pressure drop. A short distance from the orifice, however, the fluid returns to its original velocity and we regain a large part of the static-pressure drop within five or six pipe-diameters downstream from the orifice.

Upstream Pressure

On the upstream side, because of an abrupt change in the flow area, a slight pressure rise occurs at the orifice plate. On the downstream side minimum pressure does not occur at the orifice, but at some distance away from the plate. At this point the jet through the orifice attains its greatest velocity, the velocity head reaches a maximum and static head a minimum. The liquid in the tubes, Fig. 3, actually measures static pressure. At the point of minimum pressure the jet also has a minimum diameter.

The point where minimum pressure obtains is called the *vena contracta.* How far this occurs downstream from the orifice depends on several factors, such as the viscosity of the liquid, its specific gravity, size of orifice, static pressure above the orifice, size of pipe and other considerations. These are things that the average meter user does not have to worry about; they are taken care of by the meter manufacturer who gives the user carefully worked out instructions.

Mercury U-Tube

If a mercury U-tube is connected into the pipe, as in Fig. 3, the mercury in the upstream leg will fall and in the downstream leg will rise. The difference in levels represents the difference in static pressure (the differential pressure or head), in inches of mercury, between the two points in the pipe where the U-tube connects. The differential pressure varies as the square of the velocity and can be used as an accurate index of the flow rate. It is possible by a comparatively simple formula, in which the differential pressure is one element, to calculate the rate of flow at any instant.

We have just said that the differential pressure as indicated by the U-tube, Fig. 3, varies as the square of the velocity and not as the velocity. This is an important factor in an understanding of flow measurements, so let us see what it means. If the differential pressure varied as the rate of flow and, at 25% flow this pressure equalled 2 in. of mercury, then at 50% flow it would double and be 4 in. At 75% flow the differential pressure would increase three times to 6 in. and at 100% flow it would be four times 25% flow or 8 in.

Flow-Pressure Relation

In Fig. 1 this relation is plotted and the resultant curve is a straight line. If this relation were true for differential pressure, then the pointer on a flow indicator or pen on a recorder would move in proportion to the flow and the scale would be divided equally, without any adjustments being made in the meter. That is, on an indicating flowmeter the pointer would move 25% of the way around the scale on 25% flow, 50% scale for 50% flow, etc.

But the differential pressure varies as the square of the flow velocity. For example, if at 25% flow the differential pressure is 2 in. of mercury, it will be $(50^2 \times 2) \div 25^2 = (50 \times 50 \times 2) \div (25 \times 25) = 8$ in. of mercury at 50% flow. By the same process, at 75% flow the differential pressure is 18 in. and at 100% flow 32 in. of mercury. Plotting these results, we get the full-line curve Fig. 2, which rises slowly at the beginning and sharply at the upper end. Any meter that indicates or records directly from differential pressure will have a scale divided like that for inches of mercury, Fig. 2.

Uniformly Divided Scale

Many indicating and recordinig flowmeters have uniformly divided scales obtained by some device in the meter for taking the square root of the differential pressure. In Fig. 2 if we take the square root of the differential pressures we get: $\sqrt{2} = 1.4$. $\sqrt{8} = 2.8$. $\sqrt{18} = 4.2$, and $\sqrt{32} = 5.7$. Now, if we plot these square-root values against flow we get the dotted curve, Fig. 2, which is a straight line. Here we see that the square root of the differential head at 50% flow is twice that at 25% flow, or $1.4 \times 2 = 2.8$, at 75% flow 3 times or $1.4 \times 3 = 4.2$ and at 100% flow 4

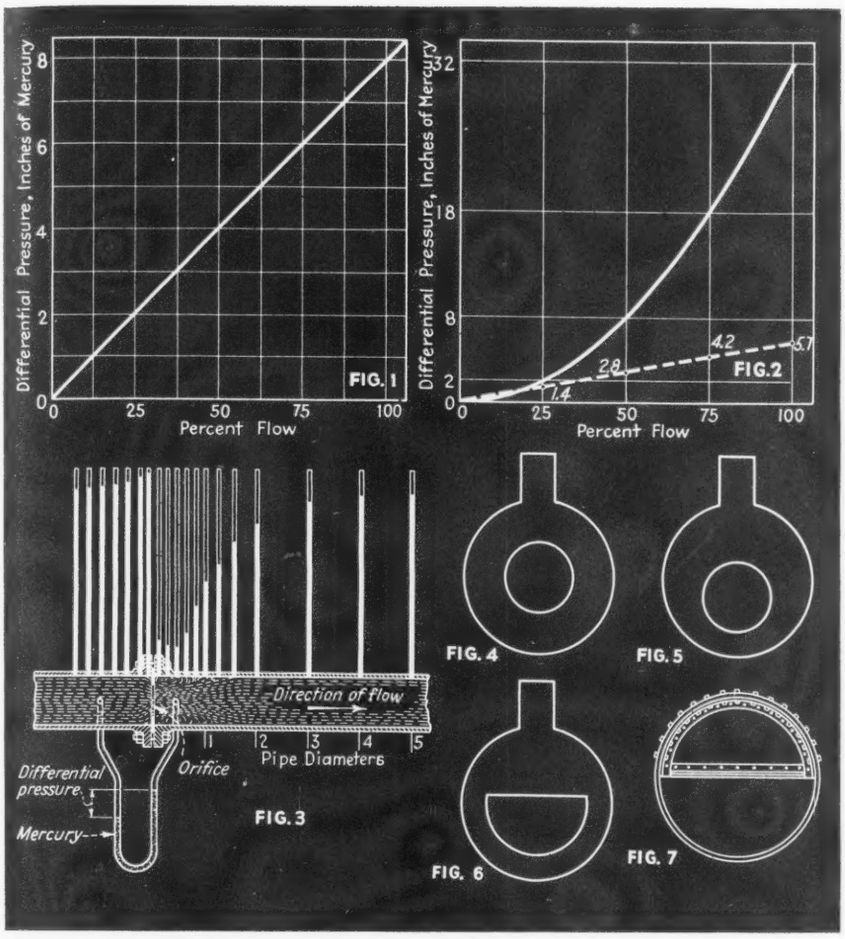


Fig. 1—Flow curve would be a straight line if differential pressure varied as flow. Fig. 2—Differential pressure varies as the square of the flow, as shown by the solid curve. Fig. 3—Differential pressure across an orifice or other primary element varies approximately as shown by the heavy vertical lines. Fig. 4—Concentric plate orifice. Fig. 5—Eccentric plate orifice. Fig. 6—Segmental plate orifice. Fig. 7—Segmental orifice made of a piece of plate with a turned flange, in a large pipe.

times, or $1.4 \times 4 = 5.6$. This is the relation that we have in Fig. 2, so that by providing some means in a flowmeter to take the square root of the differential pressure we can use an equally divided scale on indicators and recorders. This will be covered in detail in the next article.

To obtain a differential pressure for metering flow, thin-plate orifices are widely used. They can be applied for metering any kind of fluid that is reasonably clean and uniform in quality. They are not recommended for metering such fluids as sludge, because the solids tend to accumulate on the upstream side of the orifice plate and cause errors in the differential pressure.

Thin-Plate Orifices

Thin-plate orifices are low in cost, easy to install (they can be placed in existing pipeline flanges), can be used for either large or small capacities, are easily changed for a change in capacity and are accurate if properly used.

Frequently the disks are made of Monel but stainless steel, bronze, nickel and wrought iron are also used depending on pipe size and the fluid or gas being metered. Lead, hard rubber and glass are also used to meet special corrosive and erosive conditions. The plates are generally $\frac{3}{32}$ to $\frac{1}{8}$ in. thick depending on pipe size, fluid or gas pressure, and the meter manufacturer's practice. Thicker orifices may be used if pressure, flow velocity and ratio of orifice diameter to inside pipe diameter warrant them.

Thin-plate orifices are of three general designs: *concentric*, with the orifice in the center of the plate, Fig. 4; *eccentric*, with the orifice in one side of plate, Fig. 6, and *segmental*, with a segmental hole in one side of the plate, Fig. 6. The outside diameter of these plates is made such that they center accurately in the pipe by fitting snugly inside the flange bolts.

Concentric orifice plates are used on most installations and are frequently provided with a small drain hole at the bottom, which is flush with the inside bottom of the pipe for steam, to permit condensate to pass through. In water lines, the drain hole is placed flush with the top inside surface of the pipe to let air pass.

For gas lines and where fluids contain material that tends to build up back of the orifice plate, the eccentric or segmental designs are recommended. The bottom of the orifice throat is installed flush with the inside bottom of the pipe, thus permitting foreign material or liquid to pass through easily.

Eccentric Orifice Plates

Eccentric and segmental orifice plates, other things being equal, permit placing the low-pressure tap farther from the outlet of the orifice than do concentric orifices. This is sometimes a factor where flanges have long hubs. For gas mains several feet in diameter an orifice plate like Fig. 7 may be used. This consists of a segmental piece of plate with a turned flange bolted or riveted to the top inside of the pipe at some convenient location. This obviates the necessity of having a flange in, for example, riveted pipe, for installation of the orifice plate.

Where flowmeters must operate over wide ranges, such as on seasonal loads on heating lines, adjustable orifices are available. Such an orifice consists of a square-bottom plate having a width equal to the inside diameter of the pipe. This plate can be moved up and down in a chamber in much the same way as a gate valve. The lower edge of the plate forms a segmental orifice, like Fig. 7, the size of the segment depending upon how far the plate comes down into the pipe.

Orifice Calibration

The orifice is calibrated to give the required differential pressure for specific conditions of flow. It may have a sharp edge, Fig. 8, or a square edge, Fig. 10, if the disk is not more than $\frac{1}{32}$ in. thick. For thicker plates, the downstream edge is beveled to reduce the plate thickness at the rim of the orifice to $\frac{1}{32}$. Other forms are also used. A high degree of accuracy is required in making these plates and unless the meter user is in a position to satisfy these requirements he should not attempt making his own plates.

The simplest form of a thin-plate orifice is one that is installed between the pipe flanges, Fig. 8. This installation requires locating the downstream tap accurately, for proper meter operation. To meet these and other conditions several arrangements of orifice plate and tap connections are used, such as in Figs. 9 and 10.

In Fig. 9 the downstream tap is in a ring that serves as an orifice-plate holder, and is clamped between the pipe flanges. This has the advantage of accurate location of the low-pressure tap, but space must be provided in the pipe joint to install the holder. On the other hand, some plants, such as oil refineries, use flanges with solid-steel ring gaskets and the orifice plate cannot be inserted without holder.

Carrier-Ring Assembly

Fig. 10 shows a carrier-ring assembly in which the orifice plate is carried on a steel ring which has radial differential pressure taps that connect to annular grooves extending around the full circumference. These grooves are intended to average the pressure over the face of the orifice and minimize effects of uneven flow distribution across the pipe section caused by pipe bends and valves in restricted areas. Although putting the taps in the carrier does not give maximum differential pressure, it does insure accurate tap location and the pipe does not have to be bored and tapped.

For high pressures the orifice may be located in a flow unit, as in Fig. 11. This is a factory-made unit in which accuracy can be guaranteed, all parts being machined to dimensions, with the taps accurately located.

Where the orifice plate has to be located so close to the inlet of a globe valve, elbow or tee that there is not sufficient space for locating the downstream pressure tap, the "hat" orifice, Fig. 12, may be used. This type is also applied where it is not economical to insert a pair of companion flanges for the orifice plate. It is restricted to inside pipe diameters greater than 3 in. The downstream tap, located just ahead of the flange, connects through the pipe wall, by a packed joint, to the hat, which limits the use of this orifice to pipelines that operate under low and moderate pressures.

Flow Nozzles

The flow nozzle, Fig. 13, another form of differential-pressure device, comprises a short cylinder with a flared entrance. A flange on the entrance permits the nozzle to be clamped between pipe flanges. This flow nozzle is recommended for use where a rugged differential-pressure device is required and where the expense of a venturi tube is not justified. It also finds use where orifices cannot handle satisfactorily the maximum capacity desired. A flow nozzle has approximately 60% greater capacity for a given throat diameter than a thin-plate orifice.

Flow nozzles are made of bronze, steel, Monel and other metals, to suit conditions under which they are to operate. Nozzles for use in small pipes are frequently spun from a single sheet while larger nozzles are cast and accurately machined. They are frequently installed in a pipe flange, Fig. 13, with the taps made in the pipe as shown. Location of the upstream tap varies from about one pipe-diameter away from the nozzle into the flange itself. The low-pressure tap may be located in the flange, or downstream no farther than the end of the nozzle. Fig. 14 shows a flow nozzle designed to be bolted between pipe flanges, but with both taps in the flange. Where high accuracy is required or in pipes less than 3 in. in diameter the nozzle may be built into a section of pipe, which permits all parts to be assembled and machined to accurate dimensions before being installed.

Venturi tubes, Fig. 15, form one of the best known differential-pressure devices, but because of cost have not been used as generally as have some others. They are used, extensively, however, on water systems and other large water-flow lines, and where it is important to keep the net pressure loss to a minimum. With a reasonably steady flow, venturi tubes are highly accurate at any pressure, up to moderate temperatures, and at capacities limited only by size of pipe in which they are installed. These tubes are generally built in two or three sections. In the upstream section the high-pressure tap is located in the short cylindrical portion just above the entrance cone. The low-pressure tap is in the tube throat at the point of smallest cross-section.

Pressure taps are made through annular chambers, known as piezometer rings, which communicate with the interior of the tube by small vent holes. On the outside, a tapped hole stands directly opposite each hole leading into the venturi tube. A pressure connection is made to one of these holes and the others are plugged to serve as

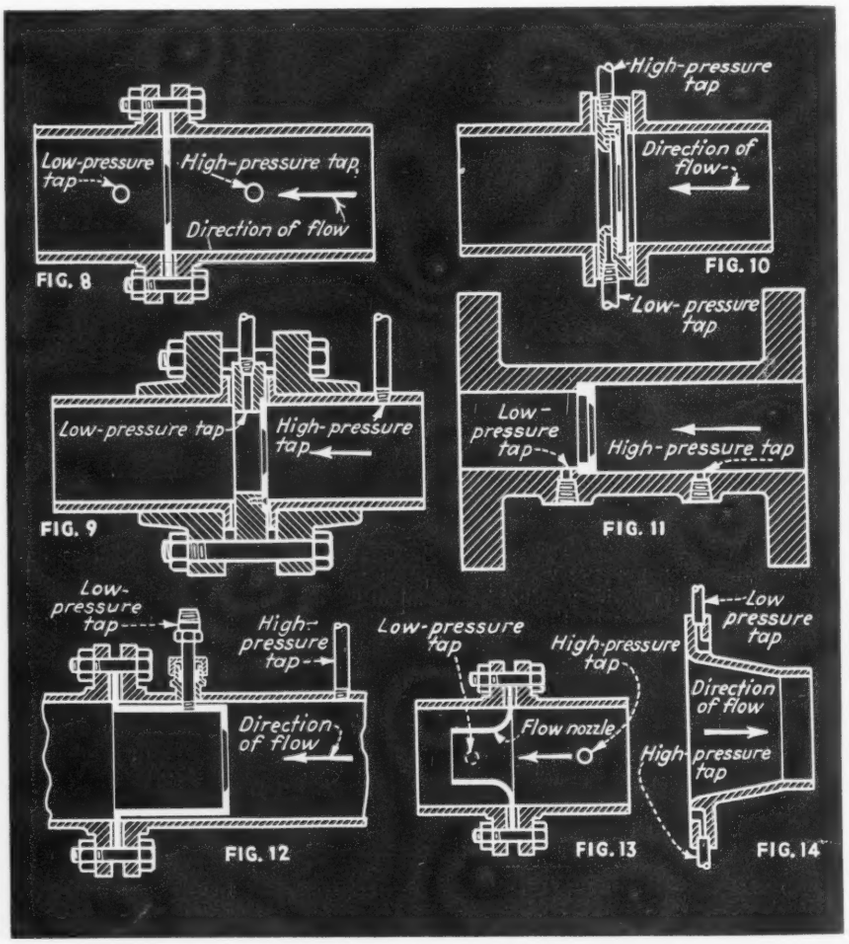


Fig. 8—Sharp-edged plate orifice between two pipe flanges. Fig. 9—Plate orifice in orifice-plate holder. Fig. 10—Square-edged plate orifice in holder with two pressure taps. Fig. 11—High-pressure plate orifice in flow unit. Fig. 12—Hat-type plate orifice. Fig. 13—Flow nozzle between a pair of pipe flanges. Fig. 14—Flow nozzle with pressure taps ready for installation between pipe flanges

cleanout holes. Venturi tubes are usually made of cast iron, cast steel, forged steel, plate steel, or sheet metal, depending on service requirements. Corrosive or chemically active liquids may be handled if venturi tubes are made of the proper materials.

What are known as venturi nozzles, Fig. 16, are also used, where space is too restricted to use a standard-length venturi tube. Head loss through a venturi nozzle is about double that for a standard venturi tube, but its initial cost is less and it requires less space to install. These tubes are also used with the pressure-recovery or discharge tube omitted, Fig. 17. Both end flanges are made to suit the pipe connections. Even though the same capacity can be measured as with a standard tube, designs like Fig. 16 and 17 have a higher pressure loss. Fig. 19 shows a short venturi nozzle built with differential pressure taps built into a section of pipe.

Pitot tubes are used for fluid measurement, but generally not with meters. They are made in different forms, but a common one, Fig. 18, consists of two small tubes screwed into a holder. The free ends of the tubes are beveled in opposite directions so that when they are placed in the pipe carrying the fluid, the bevel on one tube faces upstream and that of the other downstream. The one facing upstream is known as the *impact* tube because it receives the impact or velocity pressure of flow. The tube with the bevel facing downstream is known as the *static-pressure* tube because it receives a pressure equal to the static head less the velocity head of the fluid.

Pressure drops across pipe-size reducers, valves and elbows have been used under certain conditions for flow-metering purposes. One of the most notable applications of elbows was in the work done by Wallace M Lansford at the University of Illinois, Urbana, Ill., and published in Bulletin No. 289. Taps were taken from the inside and outside bends of the elbows, as in Fig. 20. As a result of this work the conclusion was reached that the ordinary commercial 90-deg elbow may be used successfully as a measuring device where the flow velocity is greater than about 2 ft per second.

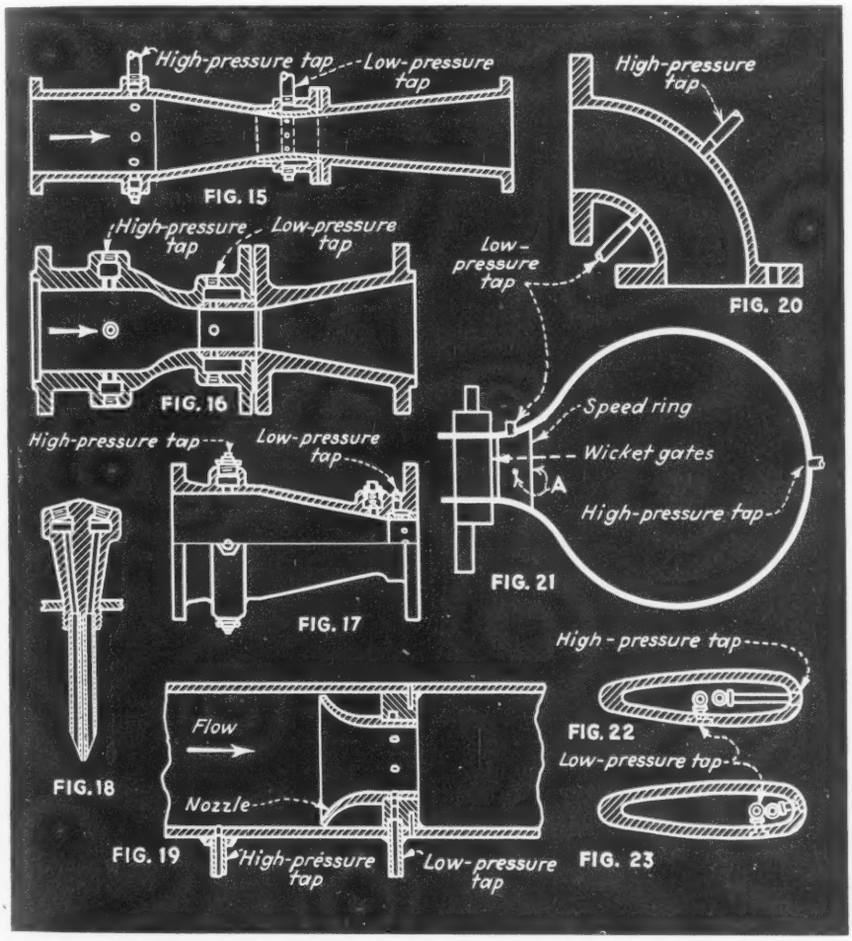


Fig. 15—Standard venturi tube. Fig. 16—Venturi nozzle. Fig. 17—Venturi nozzle without pressure-recovery tube. Fig. 18—Pitot tube. Fig. 19—Short venturi nozzle built into a pipe section. Fig. 20—Pressure taps taken from inside and outside of 90-deg elbow to measure flow. Fig. 21—Winter-Kennedy taps in waterwheel casing to measure flow. Figs. 22 and 23—Location of Peck taps on waterwheel stay vanes

Flow to Waterwheels

For measuring water flow to waterwheels, differential pressure taken from the back of the scroll case to the speed ring has been used, as in Fig. 21. The high-pressure tap is at the outer rim of the scroll case and the low-pressure at the speed ring where the water flows to the wheel. This is known as the Winter-Kennedy method and is used, in the Safe Harbor plant of the Safe Harbor Water Power Corp, to meter water flow to each of the seven 42,500-hp main Kaplan turbines and two 2500-hp service units operating under 52-ft head. Total water flow through the plant is also metered. This method was adapted to Safe Harbor conditions after exhaustive studies covering several years of work and has proved to be highly accurate (see POWER, October, November, 1940).

As a result of being able to meter the water to each turbine, station output has been increased about 0.37%, which is sufficient to pay for the metering installation in a very short time. Small variation from best operating practice are now quickly detected and corrected, whereas before the meters were installed they might have passed unnoticed. As an example of this, it is now possible to keep the losses due to trash on the intake rack appreciably below what they must have been before installation of the metering system. Now as soon as a unit shows a drop in operating efficiency by hourly reading, the rack-head losses are checked. After cleaning the racks the efficiency always returns to the expected level. Other sources of small efficiency losses have been similarly eliminated.

Peck Taps in Stay Vanes

Peck taps are also used for metering water to hydraulic turbines. These taps are made in the side and the upstream face of one of the speed-ring vanes. Figs. 22 and 23 show these taps in a cross-section of one of the vanes and approximate location in the vane is shown at *A* in Fig. 21.

The devices shown give a general picture of those used to produce a differential pressure for metering flow with head meters. Meter manufacturers, however, may use slightly different designs to meet the needs of particular meter designs, as determined by practical experience and research.

Head Meters

▶ FLOWMETERS operated from a differential-pressure or head device such as an orifice or venturi tube are known as rate-of-flow meters. They are also classified as inferential meters because the rate of flow is inferred (indicated) by differential pressure across a primary device in the flow line. This distinguishes them from the positive or quantity meters through which the total flow passes and is measured by weight or volume.

All rate-of-flow meters fall into a general class, known as head meters, and may be divided into mechanically and electrically operated groups. Mechanically operated types usually have their manometer or secondary element and indicating, recording and integrating instruments combined. Electrically operated types generally have the meter body or manometer mounted separately from the other devices. First we will consider mechanical types.

Mechanical Types

The meter body, manometer or secondary element deserves particular attention because it is a basic unit. Upon it depends the accurate measurement of the differential pressure and correct actuation of the indicating, recording and integrating instruments.

Fig. 1 shows the general design of a meter-body manometer used in a number of flowmeters. A large and powerful float F in mercury well W connects by a comparatively long lever L to a spindle shaft at S, that passes to the outside of the well through a low-friction bearing and stuffing box, B. Mercury well W connects to well W_1 by a U-tube U. The high-pressure tap from the orifice or other primary element in the flow line connects to the top of well W_1 and the low-pressure tap to the top of float-well W. We have here the equivalent of the simple U-tube, as shown in Fig. 3 of the previous article.

It should be remembered that the pressure at the high-pressure tap remains practically constant and that at the low-pressure tap decreases as flow increases. At zero flow, the pressures in the two wells are equal and the mercury comes to approximately the same level in both, with the float near the bottom of well W. As flow increases, pressure in well W_1 will remain practically constant and will decrease in W, causing mercury to flow from W_1 into W. Mercury flow from W_1 to W will continue until the differential pressure, plus the pressure in well W, equals the pressure in well W_1.

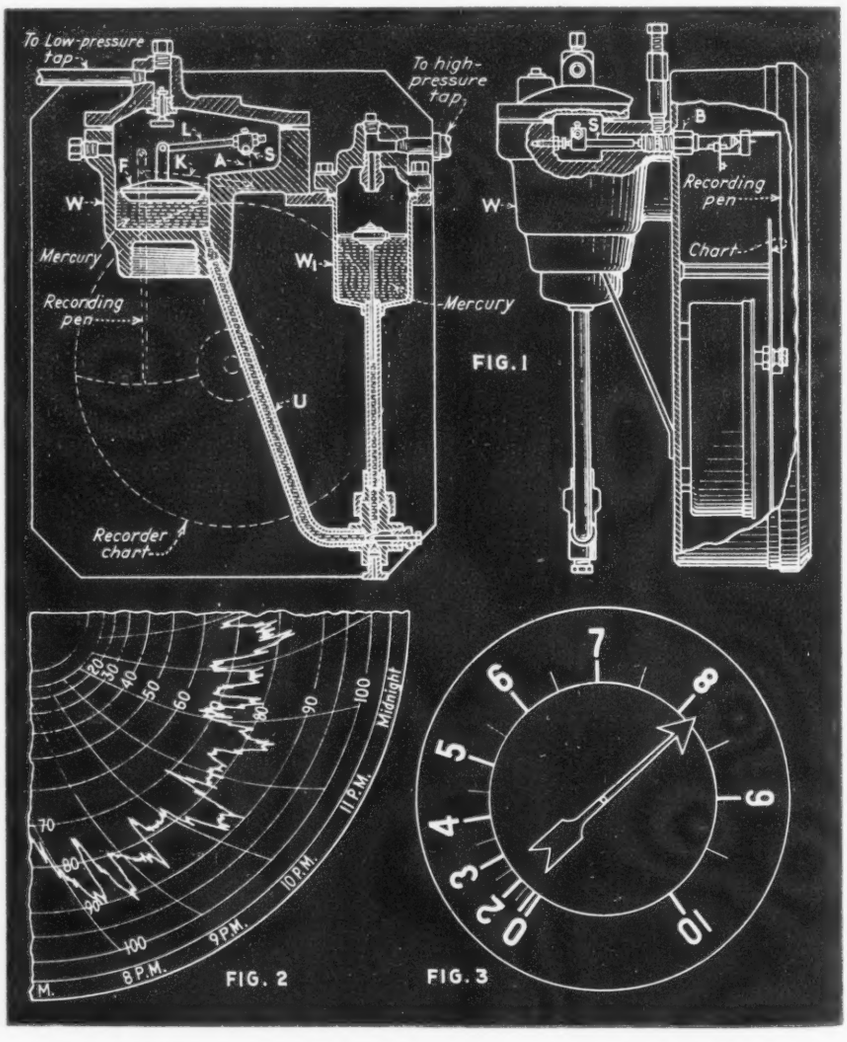
For a decrease in flow, pressure in well W increases and mercury flows into W_1 until the differential pressure and difference in mercury level balance. In this way the float, which moves up and down with the change in mercury level, takes a definite position for each rate of flow. As the float moves it rotates shaft S through part of a revolution. Each position of the float, and, therefore, the shaft, represents a definite rate of flow.

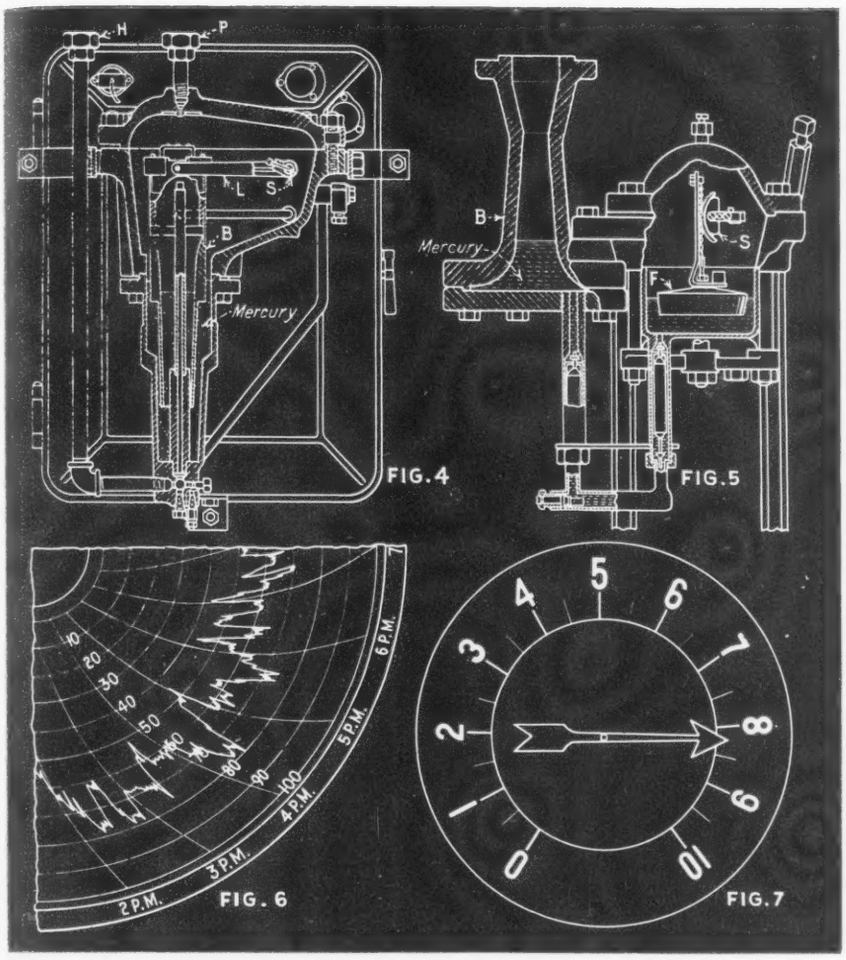
In Fig. 1 a recording pen connects by a link K to an arm A fixed to shaft S. As the float rises with an increase in flow, shaft S will turn clockwise and move the lower end of the pen toward outer edge of chart, Fig. 1. If flow decreases the float takes a lower position with the mercury and the pen is moved toward the center of the chart. By adding a fountain pen to the pen arm and a clock mechanism to rotate the chart we have a recording flowmeter in its simplest form. A chart for such a meter would be graduated like Fig. 2.

We might also mount a pointer on a shaft in bearings at the center of the chart and connect it to shaft S by a light chain on suitable sprockets. Then the pointer would be moved around the surface of the chart or dial as the float moved up and down with the mercury. We then have an indicating flowmeter and the scale of its dial would look something like Fig. 3.

Divisions on the chart and dial are small at low flow and large at high flow, because, as explained in connec-

Fig. 1—Cross-section of a flowmeter manometer that does not take the square root of the differential pressure. Fig. 2—Recorder charts such as used with the meter body Fig. 1. Fig. 3—Flow-indicator dial such as used with the meter body, Fig. 1





Figs. 4, 5—These flowmeter bodies extract the square root of the differential pressure and use an evenly divided recorder chart, Fig. 6, and indicator scale Fig. 7

tion with Fig. 2 in the previous article, the differential pressure varies as the square of the flow. Because of this, and because the mercury wells W and W_1 have uniform cross-section, the difference in mercury level in the two wells at 50% flow, will be four times that at 25% flow, nine times at 75% flow, and sixteen times at 100% flow. This is the way the scales are divided in Figs. 2 and 3, and the scales actually represent differential pressure at different rates of flow in the pipeline.

Uniformly Divided Scale

To get a uniformly divided scale we must take the square root of the differential pressure, as explained in the previous article. Some flowmeters are so constructed that they automatically take the square root of the differential pressure to give a uniformly divided chart or scale as in Figs. 6 and 7. Fig. 4 shows the meter body for such a meter. It consists of a bell B, known as a Ledoux bell, sealed in mercury. The high-pressure tap from the orifice or other primary element in the pipe line connects to the meter body at H and the low-pressure tap connects to P. These connections apply the high pressure inside the bell and the low pressure outside.

At no flow the bell is at bottom position. Here it floats in the mercury in a position that brings the indicator pointer or recorder pen to zero. An increase in flow will increase the differential pressure which, applied under the bell, will cause it to rise. As the bell rises, its walls are withdrawn from the mercury until the reduction in buoyancy balances the increase in differential pressure. Motion of the bell is transmitted through the casing by a forked lever L and spindle S to operate the indicator pointer, recorder pen and integrator. As shown by the chart, Fig. 6, movement of the pen is directly proportional to change in flow, as the chart has equal divisions. This is made possible by the shape of the Ledoux bell.

In the meter body, Fig. 5, movement of float F is made proportional to flow by the trumpet-shaped mercury chamber B on the left-hand leg of the manometer. Segmental level S, connected to the float by two chains, gives straight-line motion from float F to the recorder pen or the indicator point.

The indicating and recording elements of flowmeters are calibrated so that they indicate or record the rate of flow in pounds per hour or cubic feet per hour. Steam flowmeters usually indicate or record in pounds per hour, whereas water and gas are measured in cubic feet per hour.

The values of the scale readings on the dial, Figs. 3 and 7, range from 0 to 10 for simplicity. To get the true reading a multiplier is used such as 100, 1000, 5000, 10,000. If the multiplier is 5000, then when the indicator pointer is at 8.2, as in Fig. 3, the rate of flow is 8.2 x 5000 = 41,000 lb per hr. If this rate of flow continued constant for one hour, 41,000 lb of steam would flow through the orifice. However, except in special cases, flow does not remain constant and the indicator pointer or recorder pen is kept moving.

Flow Integrators

The integrator totals up the flow and records it in pounds or cubic feet. There are many ways of doing this but an explanation of a typical integrator, Fig. 8, will give a general idea of how they work. This integrator is driven by a little synchronous motor. The heart-shaped cam connects to the motor shaft and rotates with it at 2 rpm. By means of a friction clutch between the cam and the escape wheel, the motor also drives this wheel and the integrating counter at constant speed, when the pawl does not engage the wheel.

Now let us see how the pawl is made to engage and disengage the pawl wheel to integrate the total flow. The flow arm is attached at A to the float-operated spindle from the meter body. The roller arm is pivoted near the left-hand end of the flow arm at B, with the pawl pivoted near the right-hand end of the flow arm at C. In the figure, pawl-operating pin P is resting on the pawl arm D to hold it away from the wheel.

As flow increases the flow arm is rotated in a counter-clockwise direction by the spindle from the meter body. In doing this its left-hand end takes a lower position and with it the roller arm. At its right-hand end the flow arm rises and with it the pawl. This action moves the top end of the pawl arm away from the pawl wheel. Combination of these two actions moves the pawl so far away from the pawl wheel at 100% flow that it cannot engage the wheel at any time during a revolution, and the integrator registers all the time.

If we go to zero flow the left-hand end of the flow arm and the roller arm move upward. The right-hand end of the flow arm moves downward so that

the pawl engages the pawl wheel. In this position pawl arm D has been lowered so far that nowhere in its revolution can the cam push the roller arm down far enough to cause the pawl-operating pin to disengage the pawl from the wheel. Thus the integrator cannot register.

Between 0 and 100% flow the pawl will engage the wheel for part of each half revolution of the cam and be disengaged for the other part by the action of the cam on the roller arm, depending upon the rate of flow.

Integrator Compensators

Normally fluid meters are designed for the average pressure and temperature of the fluid to be measured. Small fluctuations above or below this average compensate one another so that the accuracy of the integration is not affected. In some cases where pressure and temperature varies through wide ranges and for prolonged periods, a compensator is recommended to adjust the integrator for pressure or temperature, or both, automatically.

Several combinations of indicators, recorders and integrators have been developed to meet special conditions. Sometimes it is important to know the amount of flow during a certain period. By the use of an automatic recording planimeter, flow in volume units can be recorded along the rim of the recorder chart as in Fig. 9. The recorder pen charts the rate of flow in the conventional way. A pen actuated by the planimeter draws a circle around the outer edge of the chart until a given volume has passed through the primary device, then the pen makes a short outward mark and returns to its normal position. Every tenth volume recorded causes the pen to move inward, thus dividing the record into groups of ten. If flow for any one hour is wanted the divisions on the scale for that hour can be counted and multiplied by the volume represented by each division.

Another combination is a recorder with an indicator scale. Such a combination is obtained by adding a fixed scale that projects from the outside of the recorder toward the center of the chart, as in Fig. 10, with an index on the pen arm. The index moves with the recording pen and clearly indicates the rate of flow. The indicating scale can be graduated to read either in the same units as the chart or any other units desired.

Other flowmeters operate on a beam-balance-scale principle, as in Fig. 11. In this design the mercury wells are two cylinders C and C_1 connected at their bottom by a tube T. At the top

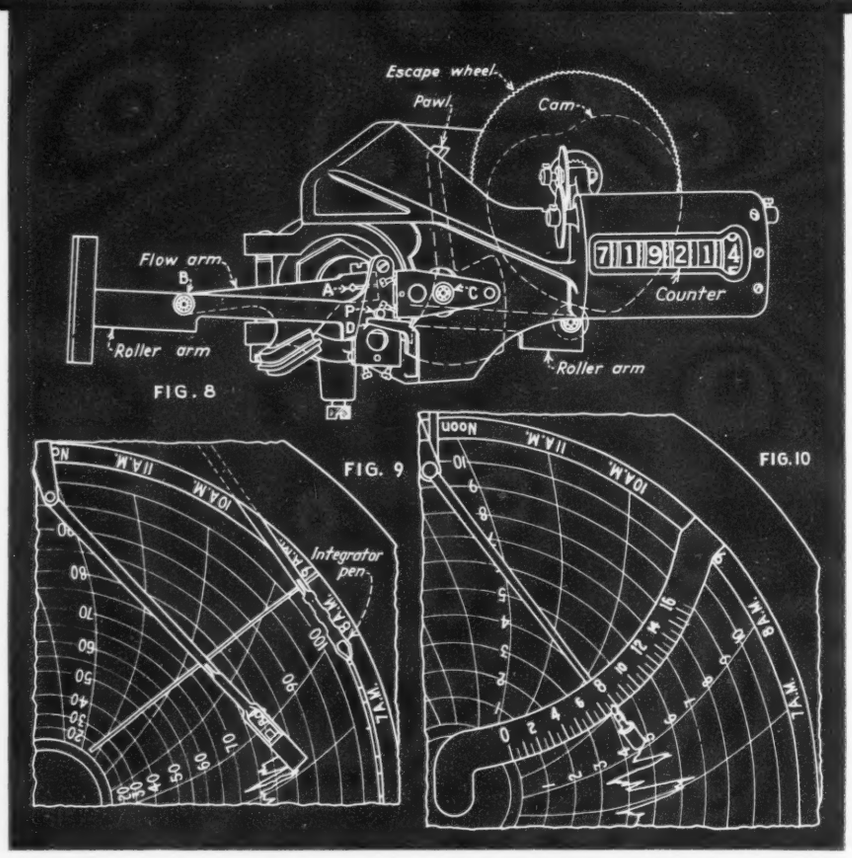


Fig. 8—One type of integrator used with flowmeters. Fig. 9—Integrator-recorder pen records total flow along chart edge. Fig. 10—Combination-recorder-and-indicator pen records and indicates in different flow units

ends the cylinders connect to a beam B supported at its center on a knife edge to reduce friction to a minimum. Cylinder C_1 connects to the high-pressure tap and C to the low-pressure tap of the primary device in the flow line.

At zero flow the cylinders are held in the position shown by cam weight W connected by a metal ribbon to the top of cam A. Under these conditions mercury is at the same level in the two cylinders. Because of the position of the balance more mercury is in cylinder C_1 than in C. An increase in flow decreases the pressure in cylinder C below that in C_1 and mercury flows to C and causes the balance to swing until a new position of equilibrium is reached.

To hold the tipping of the balance directly proportional to the rate of flow, its motion is controlled by cam A, which presses against the ribbon supporting weight W. Fig. 12, which is in position of 50% flow. A toothed sector S transmits deflection of the balance to the indicator pointer, the recorder pen and the integrator.

Figs. 13 and 14 show the operation of another flowmeter using the weigh-balance principle. The operating element in this design consists of a hollow steel ring, centered on ball bearings so that it can tilt freely about its horizontal axis. Its bottom section is filled with a sealing fluid, oil for low and mercury for high pressure.

The right-hand end of the ring connects to the low-pressure tap and the left-hand end to the high-pressure tap by flexible spring tubes. Torque of these tubes is counteracted by a compensating weight at the top of the ring which exerts an equal and opposite torque. At zero flow a calibrating weight W causes the ring to take the position, Fig. 13. As flow increases through the primary device, pressure decreases in the low-pressure end of the tube and the difference in pressure causes mercury to flow into the low-pressure end. This causes the ring to rotate about its horizontal axis until equilibrium is established between the mercury levels in the two ends of the tube and the calibrating weight. At 100% flow, the tube turns to the position in Fig. 14.

Square-Root Cam

A pointer might be attached to the ring, Fig. 13, to indicate on a square-root scale, which has small divisions for low flow and large ones for high flow as indicated. In the actual meter, however, the pen is connected to the balance ring by two cams, Figs. 15 and 16. The left-hand end of the ring cam connects to the center of the ring balance while the pen cam is geared to the indicator pointer. The action of these two cams extracts the square-root of the differential pressure and gives a uniform movement to the pointer, as shown. The recorder pen and the inte-

grator also operate from the pen cam.

Fig. 17 shows a diaphragm flowmeter for water or steam. A formed double-conical diaphragm *D* is held in position by two springs in a casing containing water. A small roller, in the end of a crank arm that actuates the indicator shaft, rests against the diaphragm. Changes in flow cause the differential pressure to change and the diaphragm moves. Each position of the diaphragm represents a definite rate of flow and the meter is actuated accordingly.

Several flowmeters have been designed that eliminate the manometer stuffing box. One of these—a water-flow indicator—is shown in Fig. 18. Differential pressure taps from each side of an orifice plate in the line connect to a pair of air traps *A* in the indicator body. These air traps prevent water from entering the indicator and act as sediment chambers. From the air traps, passages in the meter body connect to two phosphor-bronze bellows *B*. The outer ends of these bellows connect rigidly to the meter body and their inner ends connect together and through a linkage to the indicator pointer *P*. As flow increases or decreases the change in differential pressure causes the bellows to expand or contract and move the pointer across the scale in proportion to the rate of flow through the pipeline.

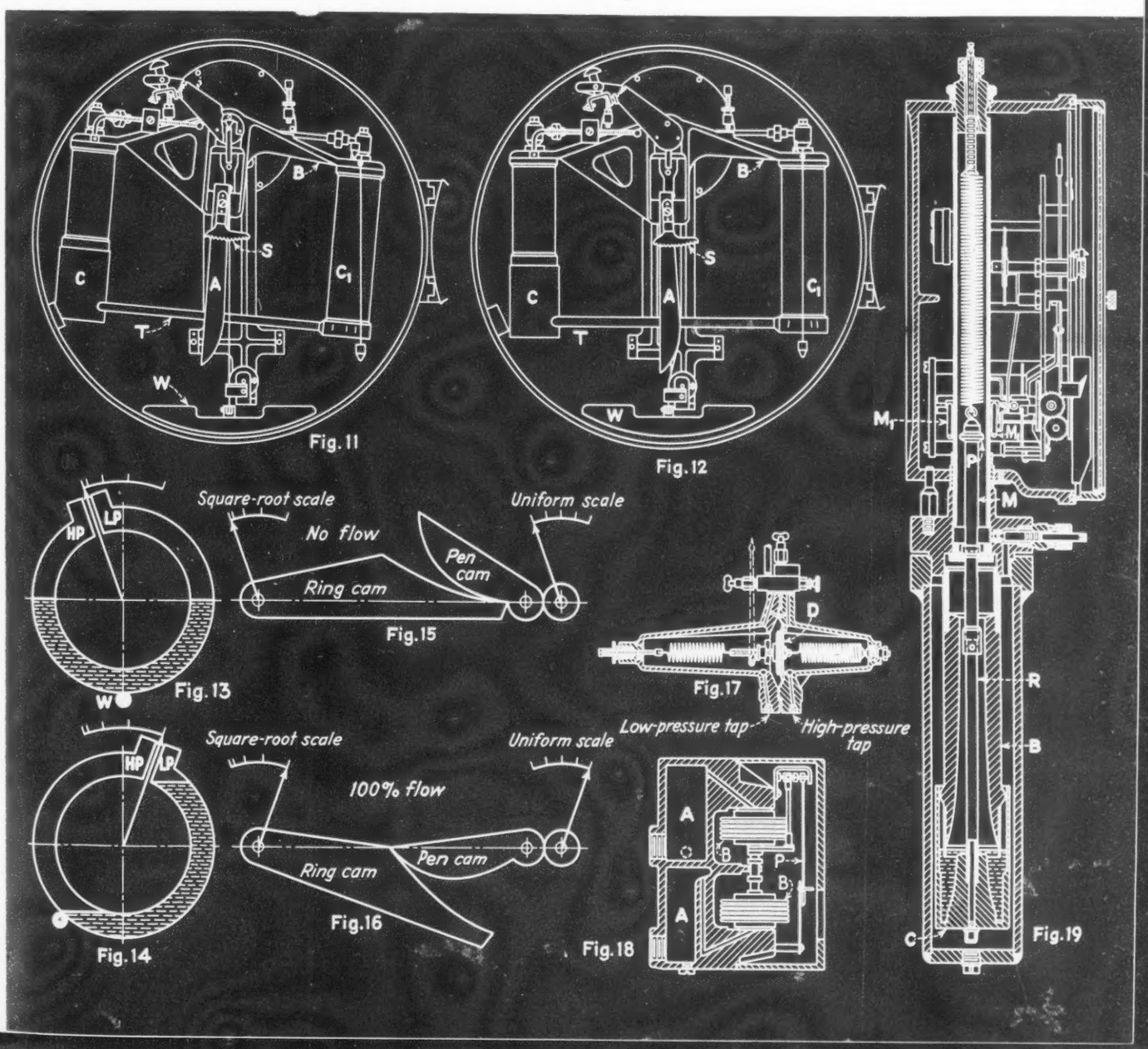
Magnetic Operation

Fig. 19 shows an indicating, recording and integrating flowmeter in which the connection between the inside and outside of the manometer is made magnetically. A rod *R* supported from its upper end by a spiral spring connects to a mercury container *C* at its lower end to form the moving element of the manometer. A fixed bell *B*, shaped to cause movement of the mercury container in proportion to the square root of the differential pressure, has its lower end sealed in the mercury.

A bar magnet *M* between the rod and spring is made of high-quality magnetic steel with a soft-iron disk polepiece *P*. The spring and transmission magnet are inclosed in a non-magnetic stainless-steel tube. The external indicating and recording mechanism carries a pair of follower magnets M_1, which are attracted to the polepiece of the internal magnet so as to follow its movement.

The high-pressure tap from the primary device connects to the space surrounding the bell and the low-pressure to its inside space. As flow increases, pressure inside the bell decreases and the higher pressure on its outside causes the mercury container to rise. The mercury level inside the bell also rises above that on the outside. This movement continues until the decreased tension in the spring

Figs. 11, 12—Flowmeter which operates on the principle of a weigh-balance scale. Figs. 13, 14—Principle of the ring-balance type of flowmeter. Figs. 15, 16—How cams extract the square root of the ring movement. Figs. 13, 14, to give a uniform scale as on the right. Fig. 17—Cross-section through a diaphragm flowmeter. Fig. 18—Metal bellows form the actuating elements in this flowmeter. Fig. 19—Connection between the inside and outside of the manometer is made magnetically



combined with the change in mercury level is sufficient to counterbalance the change in differential pressure.

The bell is so shaped internally that the movement of the mercury container is directly proportional to the flow. As the magnet at the top of the mercury container rod moves up or down with changes of flow the external magnets follow and actuate the indicating, recording and integrating devices.

In Figs. 20 and 21 a magnetic clutch transmits movement of the manometer float to the flow indicator, recorder and integrator. Fig. 20 shows a cross-section through the manometer. Changes in differential pressure due to changes in flow cause the mercury level to change and position float A, which connects by a stainless-steel ladder chain to a sheave *C* on the meter-actuating shaft. This shaft is supported in bearings and has mounted on it a magnetic rotor *R*. Both are in a non-magnetic stainless-steel mercury-filled container. A slight constant tension is always maintained in the float chain by a light spiral spring around the float shaft.

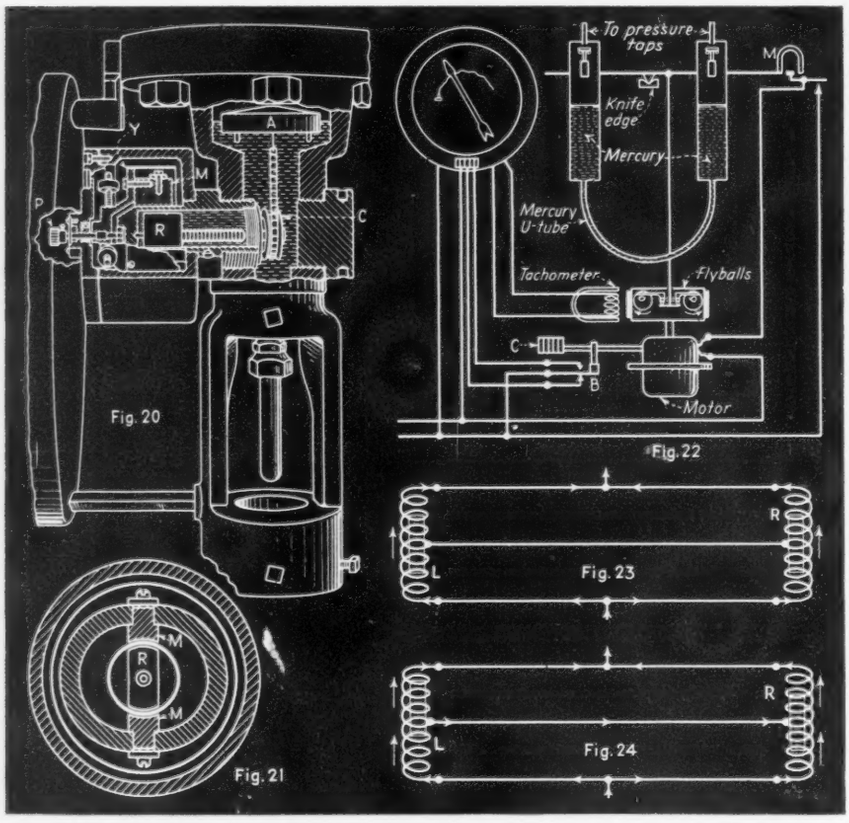
Outside the stainless-steel casing and opposite magnetic rotor *R* are two magnets *M* supported in a soft-iron yoke, as in Fig. 21. This external magnetic system is supported from a yoke *Y*, Fig. 20, on a shaft mounted on two ball bearings and statically balanced by three adjustable counter-weights. The shaft projects into the meter case where a pinion *P* actuates the indicator recorder and integrator. In Fig. 21 the north and south poles of the rotor are opposite south and north poles of the external magnetic yoke and therefore locked to them. Then, as the float moves up or down and turns the rotor magnet *R*, magnets *M* keep in step with it and transmit the float movement to the meter mechanism.

Most flowmeters classified as electrical are combinations of electrical and mechanical designs. The meter in Fig. 22 comprises a mercury U-tube on a beam, balanced on a knife edge. One end of the beam carries a permanent magnet *M* between the poles of which is one end of a mercury switch containing a piece of soft steel. From near the knife edge the beam connects by a rod to a flyball system driven by an electric motor that is also geared to a cyclometer counter integrator.

At zero flow the mercury in the two manometer legs stands at the same level and the beam is in balance. Under these conditions the magnetic switch is open and the motor stopped, indicating no flow. As flow increases, mercury flows from the right-hand to the left-hand manometer leg, causing the right-hand end of the beam to rise and close the magnetic switch. As the motor speed increases the flyballs move outward and put a downward pull on the beam that opposes the unbalance of the mercury in the manometer, and tends to open the magnetic switch.

The differential pressure that unbalances the mercury in the manometer varies as the square of the flow. Likewise, the force developed by the flyballs varies as the square of their speed. Consequently these two forces cancel each other and the magnetic switch opens and closes at a rate that will drive the motor at a speed directly proportional to flow.

By properly gearing a counter to the motor, flow in the pipe can be integrated directly. To operate the indicator and recorder, potential is used from an electrical tachometer driven by the flyballs. When an integrator is required at a distant point, such as on the indicator and recorder, an electric counter is added. This counter is operated from contacts that are opened and closed directly by the integration shaft.



Figs. 20, 21—Cross-sections through the magnetic drive used in one flowmeter. Fig. 22—Electrical flowmeter that combines a weigh beam with a flyball speed governor. Figs. 23, 24—Principle of the inductance bridge used in the meter. Fig. 25

Inductance Bridge

The inductance-bridge principle is used in two makes of flowmeters but is applied in different ways. In one make, two coils are connected into an alternating-current circuit, as in Fig. 23, forming what is known as an inductance bridge. If an iron core is centered in each coil, current will flow in the two outside wires only, because conditions in each half of the coils are the same.

Moving the core in the left-hand coil above the center of the coil, Fig. 24, will increase the inductance in the top half of the coil and decrease it in the lower half. Consequently, more current will tend to flow in the bottom half than in the top half. As a result, some of the current in the bottom half of coil *L* flows through the center connection to the top half of the coil *R*.

The top half of coil *R* now has more current flowing in it than the bottom half and exerts a greater pull on the iron core than the bottom half. This pull will continue until the core is lifted into the same position in coil *R* as in coil *L*. When this occurs inductance in the top half of each coil is the same, likewise in the bottom halves, putting the system in balance and current flows only in the outside connections to the coils, as in Fig. 23. From the foregoing it is evident that as the core is moved up or down in coil *L* the

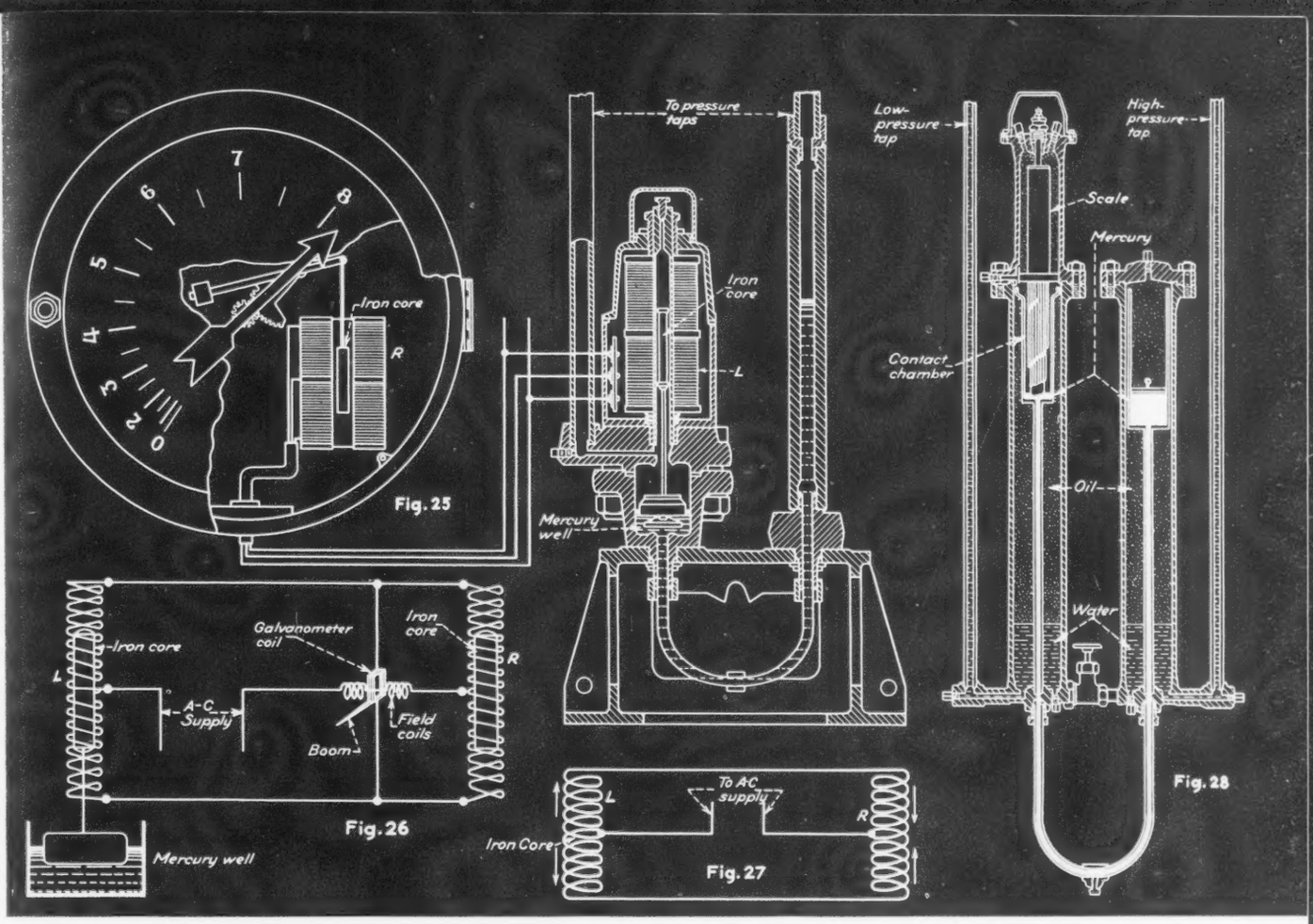


Fig. 25—Meter body and indicator of flowmeter operating on inductance-bridge principle. Fig. 26—Diagram of flowmeter that operates on the inductance-bridge principle, Fig. 27. Fig. 28—Body of flowmeter in which all operations are electrical

core in coil *R* will tend to take a similar position.

Fig. 25 shows the manometer and indicator of a flowmeter that operates on the principle of Figs. 23 and 24. As flow changes, mercury level in the manometer legs changes to position the core in coil *L* and the core in coil *R* follows to position the pointer on the indicator. A recorder or an integrator can also be operated from coil *R*.

Galvanometer Actuation

Fig. 27 shows another arrangement of an inductance bridge. Power connections are made to the center of the coils instead of to the ends, Figs. 23 and 24. Moving the core up in coil *L* will increase the inductance in its top half, and reduce it in the bottom half; consequently more current will flow in the bottom half of the coils than in the top half. This will exert a pull on the core in coil *R* to pull it down as far below the center of the coil as the core is above the center of coil *L*. When this occurs the system is again in balance and equal current flows in the two halves of each coil.

In the meter using the connection, Fig. 27, the pull on the core of the coil is not depended upon to position the indicator pointer or recorder pen or actuate the integrator. This is done by a continuously running synchronous motor through a mechanism actuated by a sensitive galvanometer. Using a motor to position the indicator and recorder insures equal power to actuate the meter throughout its range.

Fig. 26 shows the galvanometer connected into the circuit. As long as the circuits are balanced no current flows through the movable coil of the galvanometer, and its pointer (boom) remains at zero. A change in flow causes a change in the position of the core in coil *L*, which, as previously explained, causes an electrical unbalance and current flows through the galvanometer coil to deflect its pointer. Deflection of the pointer brings into operation a mechanism to position the indicator and recorder. When these have been adjusted accurately for the flow, the core in coil *R*, which is connected to the meter pointer or pen, will have been brought to a position to again balance the inductance bridge. The galvanometer needle has by this time come to zero to stop further movement of the indicator and recorder.

Electric Flowmeter

Fig. 28 is the meter body of what may be called a strictly electric flowmeter. The high-pressure tap connects to the bottom of an oil seal connected to the high-pressure mercury chamber. The low-pressure connection leads to the bottom of an oil chamber that contains the low-pressure leg of the mercury U-tube and the contact chamber.

In the contact chamber the resistance element, or scale as it is called, is made up of a series of rods connected to individual resistances. These rods are graded in length, to follow the law of squares, so that as each successive rod makes contact with the mercury, as flow increases, it causes an equal amount of flow to be recorded by the reading instruments. With this type of meter the indicator and recorder are what amount to a simple indicating and recording wattmeter, respectively, and the integrator is a watthour meter all suitably connected into an alternating-current circuit to actuate them.

Shunt Meter

Fig. 32 shows a shunt-type head meter arranged with flanged connection directly into the flow line. Differential pressure across an orifice *O* causes part of the flow to go up through the turbine rotor *T* in the shunt circuit as indicated by the arrows. The turbine shaft connects to a damping fan *F* and a reduction gear in a water chamber. A magnetic drive *D* connects the turbine shaft to the integrator. Action of the damp-

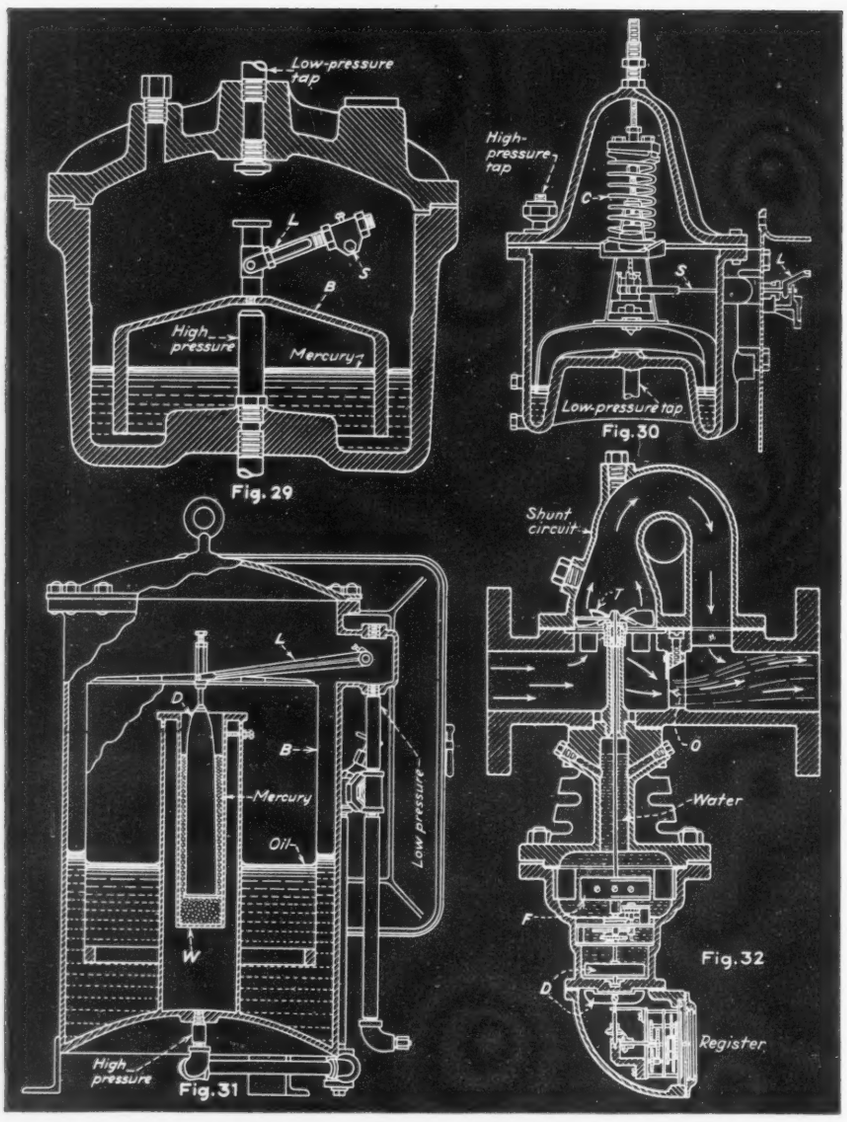


Fig. 29—Single-chamber manometer for operating a flowmeter on low-pressure lines. Fig. 30—In this low-pressure manometer the movable bell is supported from a spring. Fig. 31—Low-pressure manometer extracts the square root of the differential pressure to give an evenly divided recorder chart and indicator scale. Fig. 32—Cross-section through a shunt flowmeter in which part of the flow operates the meter

ing fan *F* causes the turbine to run at a speed proportional to flow. This meter integrates only; if a recorder or indicator is to be operated it is connected to pressure taps on each side of the orifice.

Low-Pressure Meters

When pressures are low, such as in gas lines, the differential pressure may be insufficient to operate the meter bodies previously described. On medium- and high-pressure lines differential pressures across the primary device may equal 50 to 200 in. of water whereas on low-pressure gas lines, maximum differential pressure is within the range of 1 to 10 in. of water. For such conditions, instead of using a meter body like Fig. 1, the single-chamber design, Fig. 29, may be used. A bell float, *B*, sealed in mercury, connects by adjustable lever *L* to shaft *S* that actuates the indicator, recorder and integrator, as in Fig. 1. The high-pressure differential tap connects under the bell and the low-pressure tap above. As the differential pressure changes with flow the bell moves up or down accordingly to actuate the indicating or recording devices.

In the low-pressure meter, Fig. 30, the bell is also sealed in mercury, but is supported from a calibration spring *C*. The low-pressure tap connects to the under side of the bell and the high-pressure to the outside. As flow increases or decreases the bell moves down or up and rotates shaft *S* to position the indicator pointer or recorder pen through lever *L*.

A meter body for low pressures, which is a modification of the design in Figs. 6 and 7 is shown in Fig. 31. In this unit the operating parts consist of a large straight-walled bell *B*, sealed in oil, to which is attached the forked lever *L* for actuating the indicator and recorder. A specially shaped displacer *D* hangs from the top of the bell and floats in mercury well *W*. The high-pressure tap connects to the inside of the bell through the column supporting the mercury well. Low pressure is applied outside the bell.

A change in differential pressure causes bell *B* to move up or down to a position where the change in buoyance due to the position of displacer *D* in the mercury balances the change in differential pressure. Movement of bell *B*, because of the special shape of the displacer, is proportional to the rate of flow, as in Figs. 6 and 7.

Duplex Metering

Where flow rates vary widely and high accuracy is essential at both low and high flows, such as on natural-gas applications, a duplex metering installation is sometimes used. One of the meters is suitable for minimum average flow and the other has a differential range sufficient to measure maximum flow. Both meters connect to the same differential pressure taps, and record the flow until the differential pressure exceeds the limit of the low-reading flowmeter. At that time the low-flow pen remains outside the chart scale and the record continues on the high-range chart. For low flow, readings of the low-range meter are used and for high flows the high-range records apply.

For installations where the flow at certain periods or seasons is greater than at others, a meter with two high-pressure chambers is used. When both are in use the maximum differential range is 20 in. When only the higher pressure one is in use, its maximum differential-pressure range is 100 in. Either two different charts or one chart may be used to record low and high flow. When one chart is used for both, two different multipliers must be applied to calculate the rate of flow.

Two flow meters (dual meters) combined into one casing and recording on the same chart, solve the problem of related flow records. This combination is often used when a change in rate of flow of one fluid requires a change in rate of flow of another. The relation that one bears to the other is more easily observed if both flows are recorded on the same chart.

Other constructions and arrangements of head flowmeters are available, but those shown give a good general idea of their construction, operation and method of application.

Area Meters

▶ FLOW OF FLUIDS that are dirty, like boiler blowdown or that have a high viscosity, like heavy oil or tar, is difficult to measure with head meters. Dirty liquids tend to foul orifice plates or nozzles and clog pressure connections to meter bodies. Tar and heavy oil must be heated to flow freely and if metered with head meters require special heating arrangements to prevent the liquid congealing on orifice plates and in pressure connections. Volatile and corrosive fluids are also difficult to meter accurately. For such applications, as well as for more easily measured fluids, what are known as area meters are frequently used.

These meters connect directly into the line and take the total flow through them. In them a valve or piston is lifted by the flow to vary the area of an orifice. The area of the orifice is a measure of the flow, hence the name. These meters are simple in construction and some of them are inexpensive. They thus find use where a low-cost indicating and, in some cases, recording meter is needed, on air and other lines.

A cross-section through one area meter used extensively on steam lines is shown in Fig. 1. At zero flow, a tapered plug *P* closes an orifice *O* as shown. As flow increases the plug is lifted to a position proportional to the volume passing through the meter. A dashpot *D* connected to the bottom of the plug prevents it from overtraveling if a sudden change in flow occurs. The plug moves up or down on a guide rod *R*. Lever *L* connects to the indicator and recorder at *A* and is positioned by plug *P*.

The flow indicator, Fig. 2, was developed to indicate accurately the flow of hot, dirty, blowdown from steam boilers. It is also used to meter condensate, light oils, gasoline, milk, chemicals and other fluids. Flow enters the indicator below plunger *P* and forces it up off its seat and exposes slots in the plunger through which the liquid flows to the discharge side of the indicator. An increase in flow will increase the lift of the plunger to expose a greater area of slots. At the top of the plunger rod a dashpot *D* with a loose-fitting piston tends to dampen out rapid pulsations. One end of an arm *A*, fixed on the indicator shaft, rests on the top end of the plunger rod and transmits its vertical motion to the indicator pointer.

The area meter, Fig. 4, is electrical and operates on the same principle as the head meter, Fig. 25, page 79. Flow through the meter body positions weighted piston *P* to uncover an orifice in sleeve *S*. The iron core *A* in coil *C* connects to piston *P* by a non-magnetic rod. As the piston moves up or down in sleeve *S*, in proportion to flow, it positions the core in coil *C*. From here, operation of the indicating, recording and integrating instruments is the same as in Fig. 25, page 79.

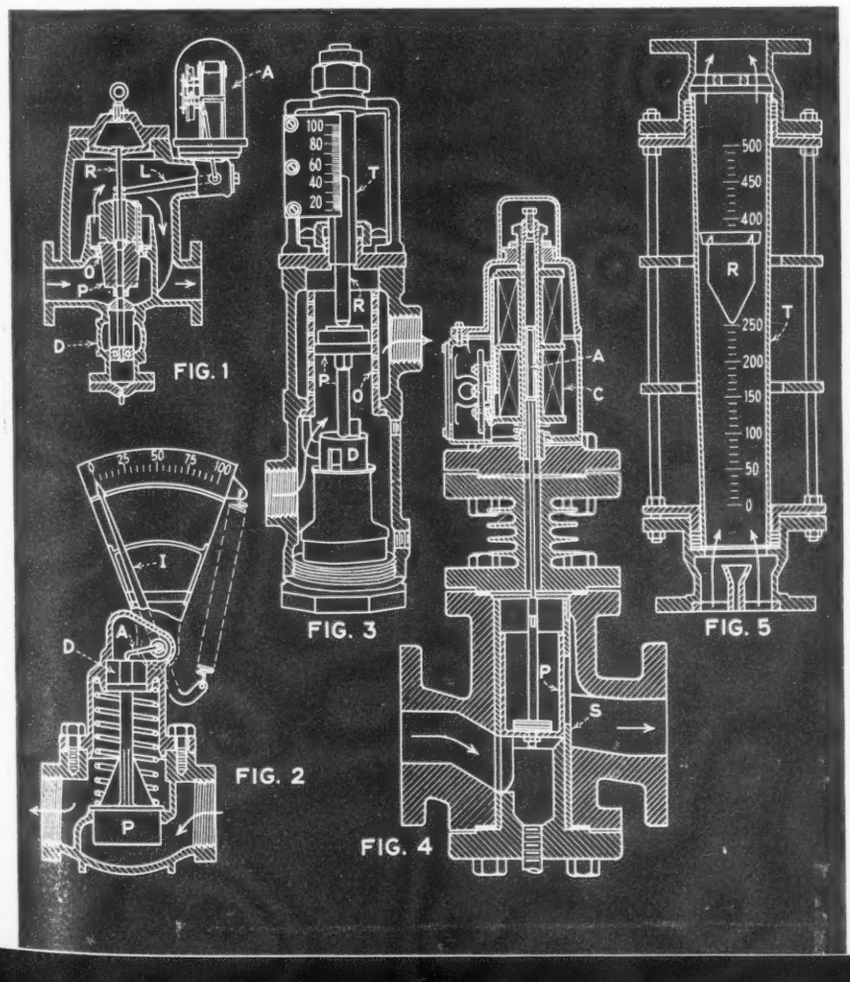
Air-Flow Indicator

The meter, Fig. 3, is intended chiefly for air lines and indicates rate of flow only. Air is admitted under piston *P* which moves up or down as flow increases or decreases, to increase or decrease the number of orifices *O* uncovered in the cylinder wall. Bottom of piston *P* connects to a dashpot *D* to prevent overtravel or sudden change in flow. An indicating rod *R* extends up from the top of the piston into a glass tube *T* with a scale graduated in cubic feet of air flow per minute. At zero flow the top end of rod *R* is at zero on the scale and moves upward with increased flow.

The area meter, Fig. 5, consists of a vertical glass tube *T* having a tapered bore, with the small end down, and a top-shaped float *R* inside the tube held in suspension by the upward flow of liquid or gas. Being free, the float is caused to rotate by means of slots cut in its head against which the current impinges, and floats in the center of the stream. Space between the float and tube increases as the float is carried upward by increasing flow. Position of the float is in direct relation to rate of flow, therefore the scale is equally divided, as in Fig. 5.

Head meters described in the previous article operate with a constant-area orifice and differential head increases with flow, whereas in area meters, differential head remains practically constant and orifice area varies with flow.

Fig. 1—Position of tapered plug *P* is a measure of flow through this meter. Fig. 2—This meter was developed to measure hot blowdown water from boilers. Fig. 3—Intended chiefly for air lines, this meter indicates flow only. Fig. 4—Electrical meter operates on the inductance-bridge principle. Fig. 5—A rotating float in a glass tube gives a direct measure of flow through this meter



Quantity Meters

▶ ANOTHER LARGE GROUP of meters includes those that measure flow volume directly. These are classed as quantity or volume meters and are represented by the water and gas meters found in homes and industry. In all designs the integrating device is driven directly from the metering element. Indicating and recording devices can be attached to these meters but they are seldom used except in special applications. This is in contrast to the head and area meters considered in the previous articles in which indicating and recording is a primary operation and integration a secondary one.

Quantity meters connect directly into the line, as in Fig. 1, and are therefore limited as to temperature of the liquid or gas that they can handle. Many of these meters are suited for handling cold water only, some can handle hot liquids and others cold gas. Where high-temperature gas and liquids must be metered the answer to the problem is generally a head meter. With these the metering elements can be isolated from the high temperature and only the primary element placed in the flow line.

Current Meters

Quantity or volume meters may be divided into two general classes: positive-displacement and current types, the latter also as velocity, turbine or inferential meters. Of the two classes, current meters are the most simple in their operation and will be considered first. In all current meters the driving medium is some form of impeller placed in the flow line. Since the torque developed by an impeller varies as the rate of flow cubed, at low flows it becomes extremely weak. For this reason, current meters generally should not be used on lines where the flow will be light for long periods.

Current meters are well suited to large flows and are used where periodic or continual high rates of flow occur. Where high and low flow rates occur in the same line, a large current meter is combined with a small positive-displacement unit. Up to a certain rate of flow the liquid passes through the positive-displacement meter. When this limit is exceeded, the current meter automatically comes into service. Such arrangements are known as compound meters.

Fig. 2 shows one type of current meter that is built in line sizes of from 1.5 to 20 in. and for maximum flows of 100 to 25,000 gpm. respectively. The impeller in this meter is two helical gear wheels, *G*, one left hand and the other right hand, mounted on a vertical spindle and carried on an agate bearing *B*.

The impellers, molded of hard rubber, have hollow, water-tight chambers. Their weight, plus that of the phosphor-bronze shaft upon which they are mounted, only slightly exceeds that of the water they displace. Therefore they practically float in still water. Since flow is up through the bottom impeller and down through the top one, they are hydraulically balanced, and there is practically no weight on bearing *B*.

Cast-bronze cages *C* protect the impellers from damage by foreign matter that might get into the flow line. The incoming water divides into two equal streams flowing through both impellers. These streams react upon each other, radiate in all directions and pass out at a right angle to the line of impact through ports in the bronze housing *H* to the large chamber just back of the meter outlet.

At its top end, the impeller's phosphor-bronze shaft connects to a gear train *T* that is enclosed in oil to protect it from corrosion and foreign matter and to minimize friction and wear. The output shaft of the gear train connects to the register in the top of the meter. This register may be round reading, Fig. 3, or straight, Fig. 4. Either one has a range of 0 to 100,000 cu ft. Special registers that show gallons per minute or any other unit of volume desired are obtainable.

Range of Registers

Registers are also made with as many as eight round or straight readings on them for a range of 0 to 10,000,000 cu ft. On some registers the one-foot scale is placed around the outside of the register, with a long pointer driven

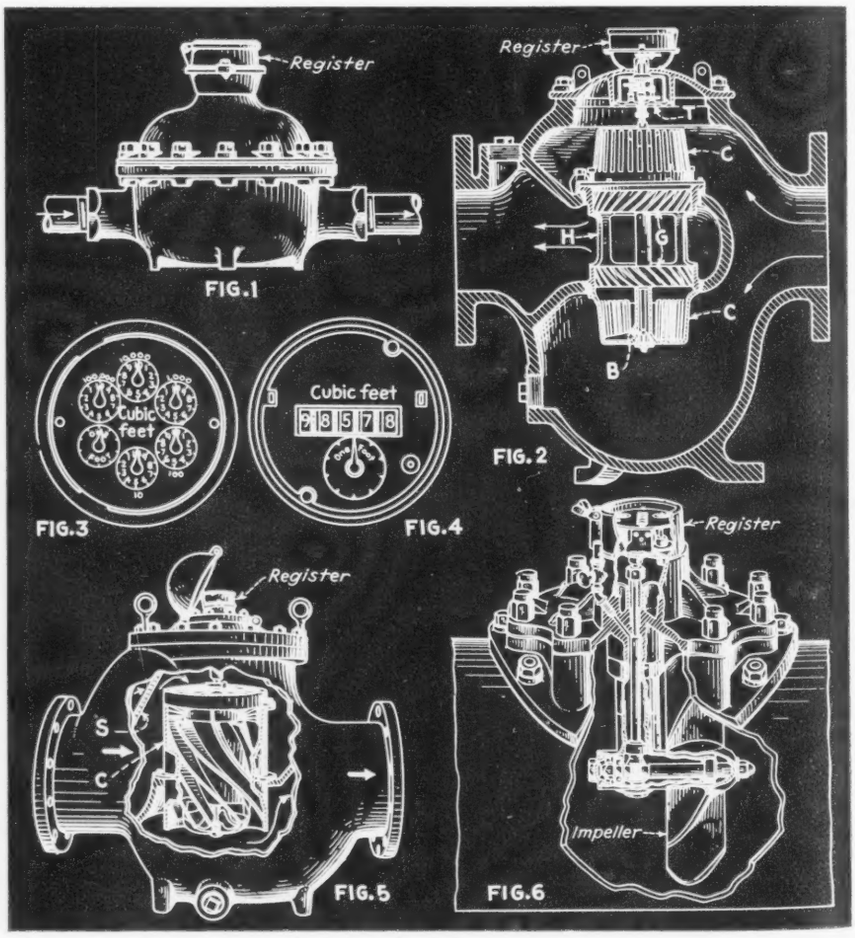


Fig. 1—Positive-displacement water meter connected directly into the pipeline. Fig. 2—Cross-section through double-gear current meter. Fig. 3—Round register. Fig. 4—Straight register. Fig. 5—Current meter for measuring large quantities of water. Fig. 6—Saddle current meter installed in large pipeline

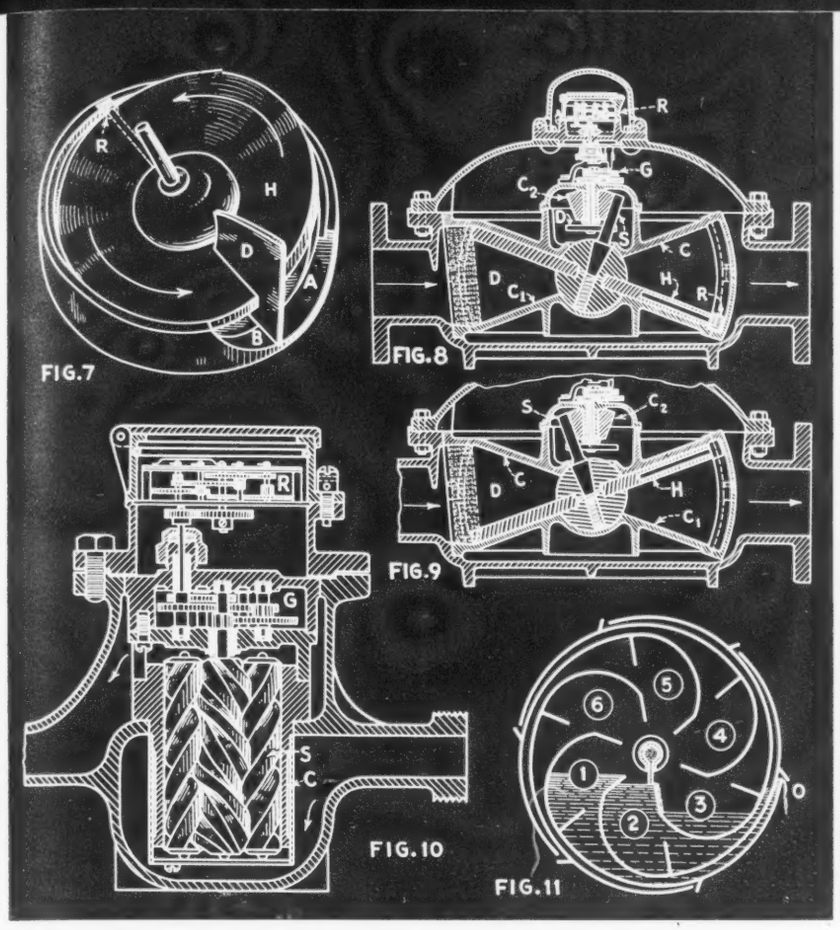


Fig. 7—A nutating disk *H* is the impeller of this positive-displacement meter. Figs. 8, 9—Nutating disk *H* in two positions. Fig. 10—Rotor of this positive-displacement meter is like that of a screw pump. Fig. 11—Measuring drum of a meter for measuring condensate returns from steam-heating mains

from the center of the register. This dial is used for testing the meter, checking for leaks after the meter is installed and to determine if the meter is registering on low flows.

Measuring Large Volumes

Fig. 5 shows another design of current meter for measuring large volumes of water such as main supply lines on systems supplying factories or other industrial and commercial services, without retardation of flow or perceptible reduction of the effective head or pressure. The propeller, which is a vertical cylinder with thin helical vanes molded on its surface, is made of hard rubber of about the same specific gravity as water, and is supported on a Monel-metal shaft, operating on a jeweled bearing.

The arrows indicate direction of flow, which is first through a strainer *S*, then down through the measuring chamber *C*, where it contacts the vanes on the impeller and causes it to rotate in direct proportion to the volume of water passing through. A device at the bottom end of the impeller practically eliminates the downward thrust of the water on the vanes, thus relieving the bottom bearing of practically all load.

The current meter, Fig. 6, is called a "saddle" unit. In some cases these meters are bolted directly by a saddle to the pipe line, as in the figure. In other designs they are built into a section of pipe and connected to the flow line by flanged or other types of pipe ends. The impeller, which has a diameter equal to 0.8 of the diameter of the pipe in which it works, is made of an aluminum alloy or Bakelite. It has six blades and its shaft is supported in two stainless-steel ball bearings. A worm on the impeller shaft meshes into a gear wheel on a vertical shaft that drives the register. Because the impeller traverses nearly the entire cross-section of the pipe it will rotate in the stream in direct ratio to the volume of flow.

Positive-Displacement Meters

Positive-displacement meters usually measure fluid or gas in some kind of a chamber having a given volume. Of the several types that have been developed the nutating-disk type is one of the oldest and most widely used. The impeller in this meter is a hard rubber disk *H*, Fig. 7. Through one side of this disk a vertical diaphragm *D* acts as the division between the meter intake *A* and discharge *B*. At the back of the disk an anti-friction bearing roller *R*, supported in the disk, takes the thrust. This roller runs in a slot cut in the inside of the measuring chamber and therefore holds the disk in proper alignment.

Fig. 8 shows a cross-section through a nutating-disk meter with its parts lettered as in Fig. 7. The disk *H* is supported on a hard-rubber ball between two flat cones *C* and C_1 and its shaft *S* rests against the frustrum of a cone C_2. On the right, the disk contacts cone C_1 and on the left it rests up against cone *C*. In this position the disk divides its chamber into an intake compartment under the right-hand side of the disk, looking at the intake, and into a discharge compartment above the disk on the discharge side.

Nutating-Disk Operation

If a valve is opened on the discharge side of the meter, pressure will drop above the disk. The higher pressure of the incoming water under the back side of the disk will lift its right-hand side and move it to the position, Fig. 9. In doing this shaft *S* moves around behind cone C_2 to the position shown. The space above disk *H* has now become the intake compartment and the space below the disk the discharge. Excess intake pressure above the disk pushes it down and in the next half cycle of operation will cause it to take the position in Fig. 8. From this it is seen that the difference in pressure on the intake and discharge of the meter causes the disk to wobble or nutate so that shaft *S* rotates about cone C_2. In so doing water is trapped, first on one side and then on the other side of the disk and is forced out by the difference in pressure between the intake and discharge side of the meter. If only a small amount of water is taken from the discharge side the disk moves slowly; if a large amount of water flows the disk moves faster. When the discharge is closed the disk comes to rest. As shaft *S* moves around cone C_2 it drives an arm which through its vertical shaft drives the register *R* through the intermediate gear train *G*.

The positive-displacement meter, Fig. 10, is built on the principle of a well-known screw pump. The metering element consists of three vulcanized hard-rubber screws *S*, that mesh with each other and fit into the bore of a non-corrosive nickel-bronze casing with close clearance. These screws are called rotors and their surrounding casing the measuring chamber. In Fig. 10 water enters the measuring chamber from the bottom and as it flows upward the rotors are turned. This operation is just the reverse of what happens when the rotors are driven in a pump. The threads of the rotors act as a continuous piston.

which always move forward. The center rotor, known as the power rotor, drives the register R through an oil-enclosed gear train G. The two side rotors are known as idlers, do nothing but serve as seals for the power rotor.

Fig. 11 shows the measuring drum of a meter intended for measuring condensate from steam-heating lines. As the condensate flows in at the center of the drum and fills the bottom compartments, the center of gravity of the drum shifts and causes it to rotate clockwise and drive the register. In Fig. 11 compartment 1 is full and overflowing at O. Compartment 2 has filled and is overflowing into No. 3. As compartment No. 3 fills, the drum will continue to turn clockwise, No. 1 will empty, and No. 4 will begin to fill. In this way a given volume of condensate is discharged by each compartment. This type of meter cannot be used on a pressure line because all the compartments in the drum would fill and the meter become inoperative.

Float-Operated Meter

The positive-displacement oil meter, Fig. 12, is float-operated. Oil comes into the meter at A through a strainer S and inlet valve V and is discharged at D through outlet valve V_1. As the metering chamber fills and empties, float F moves up and down on rod R. When the metering chamber is full the float is in the position shown and has operated the toggle mechanism to close inlet valve V and open outlet valve V_1. When a predetermined volume of oil flows from the metering chamber the float is at its lowest position and by its weight operates the toggle mechanism to close outlet valve V_1 and open inlet valve V. Movement of the float rod with the valve-operating mechanism moves lever L up and down to operate the register and record the volume of oil passing through the meter.

Bellows Gas Meter

Fig. 13 shows the old positive-displacement bellows gas meter. This meter, which is sealed in a gas-tight tin container, operates on the principle of a slide-valve engine and what are the equivalent of two slide valves are shown at D and D_1. The two bellows B and B_1 are separated from each other by a partition A so that each bellows operates as an individual unit in a compartment by itself. Each bellows connects by a bracket to what is called a flag F on a post P that is rotated through an arc by the bellows B as it expands and contracts with inflow and outflow of the gas.

Gas is admitted alternately by the D valves to the outside and the inside of the bellows. When valve D is admitting gas to the inside of bellows B valve D_1 admits gas to outside of B_1. The valves are also in a position to let gas flow from outside of bellows B and inside of B_1 into the service line. When a valve is opened in the service line its pressure drops and the higher pressure from the main inside bellows B expands it outward and forces the gas on its outside into the service line. The reverse of this takes place in bellows B_1. At the end of this operation bellows B is full of gas likewise the space outside B_1. When the D valves reverse, this gas is admitted to the service line. Each time the bellows fill and empty, a measured quantity of gas is supplied to the service line from the meter and recorded on the register.

When it is necessary to meter large volumes of water through a line at one time and small volumes at others, compound meters may be used. There are several of these, but the one shown in Fig. 14 gives the general details. Two meters, a small-capacity one A like Fig. 8, and a large capacity unit B like Fig. 5, are combined in a single casing with an automatic valve V. At low flows valve V is closed, as in the figure, and all flow is through the small meter as indicated.

When a large draft of water is taken from the line, pressure above valve V drops so that line pressure below lifts the valve until it seats at S. This stops the flow through the small meter and all flow is down through meter B and up through valve V. When flow stops or is reduced to a low value, valve V drops on its lower seat and meter A is again in service. The sum of the readings of the two meters gives the total flow through the pipeline.

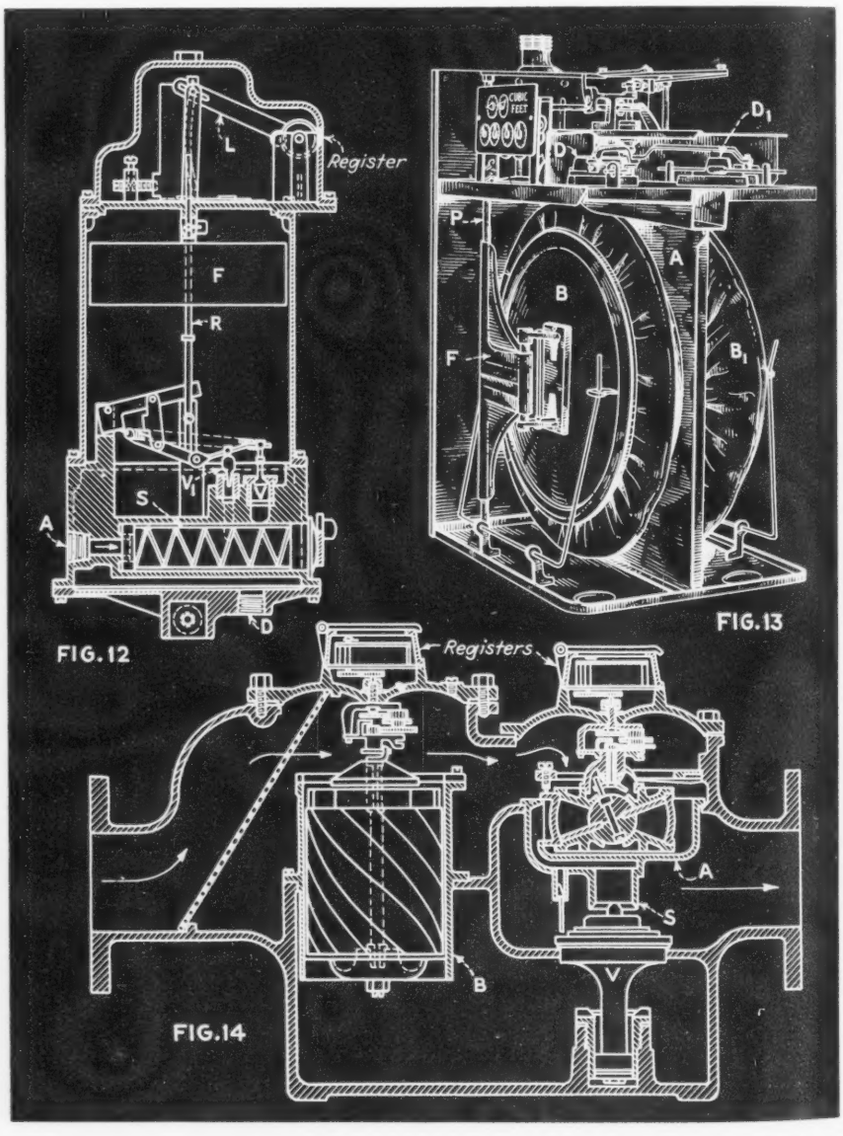


Fig. 12—Float-operated, positive-displacement oil meter. Fig. 13—Positive-displacement bellows gas meter. Fig. 14—Compound meter combines a large-capacity current meter for high flows with a nutating-disk, positive-displacement meter for low flows

Weirs and Weir Meters

WEIRS ARE GENERALLY USED for measuring flow in some form of open channel, particularly where the flow cannot be conveniently passed through an orifice, nozzle or venturi tube. A weir in effect is a dam over which the liquid to be measured, usually water, flows. Weirs may be classified as rectangular, V or triangular, trapezoidal, parabolic, hyperbolic, cycloidal, circular, etc. The most commonly used forms are the rectangular and triangular.

A rectangular weir may be either suppressed, Fig. 2, or contracted, Fig. 3. In Fig. 2 the weir extends across the full width of the flume box in which it is installed. Where the bottom of the discharge comes out over the crest it is suppressed upward, but the sides of the stream are parallel to the sides of the weir box. In Fig. 3 the weir is narrower than the flume box and all its upstream edges are sharp to insure line contact.

Fig. 6 shows a cross-section through a weir. The height H of the water level in the flume above the crest of the weir is measured by a hook gage. This distance is known as the head on the weir and is measured behind the point where the water begins to accelerate to go over the weir. Knowing the width of the weir, and the head on it, the flow over it can be calculated by a formula. As the head on the weir increases, the velocity and cross-sectional area of the discharge increases. For that reason weir meters which we will consider are also known as head-area meters.

The V-notch or triangular weir is one of the best known, from its use in feedwater measurements. Fig. 1 shows the general arrangement of one V-notch meter. The float in a stilling well outside the weir flume rises or falls with a change in flow. Motion of the float is transmitted by a rod to a flow indicator pointer, which is moved over a scale, S, to show the rate of flow through the weir notch. A rack, B, on the float rod meshes into a pinion, P, to turn a drum cam, C. The recording pen R is supported on a shaft D. A pin in arm A, fixed to shaft D, rides in the spiral groove of cam C. As the cam is rotated by the movement of the float the pen travels across the chart to record the rate of flow. An integrator can also be added to record the total flow through the V-notch.

The V-notch through which flow is measured may have an angle as small as 30 deg for small-capacity meters and as high as 90 deg for large-capacity meters.

Quality of Liquid

While it is preferable to have the liquid clean when it is passing through weir meters, liquid carrying considerable quantities of suspended matter can be accurately metered provided that it does not carry sticks or other objects that would lodge on the weir. A parabolic weir notch is shaped like Fig. 4. A feature of this notch is that the flow through it is directly proportional to the head, whereas over a V-notch, flow varies as the 2.5 power of the head.

The Parshall venturi flume, Fig. 5, which may be considered a form of weir, is used extensively for measuring flow through open channels, such as water for irrigation, white water in paper mills, and sewage. The flume consists of a converging entrance section and a diverging outlet section joined by a throat, all with vertical walls.

Head on the converging section is measured by a pipe connection placed flush with the inside wall and at the floor level of the section. This pipe, which should be 1-in. size for clean and 2-in. for dirty liquids, connects to a well in which a float rides. The float connects to the metering device which changes its movement into flow units.

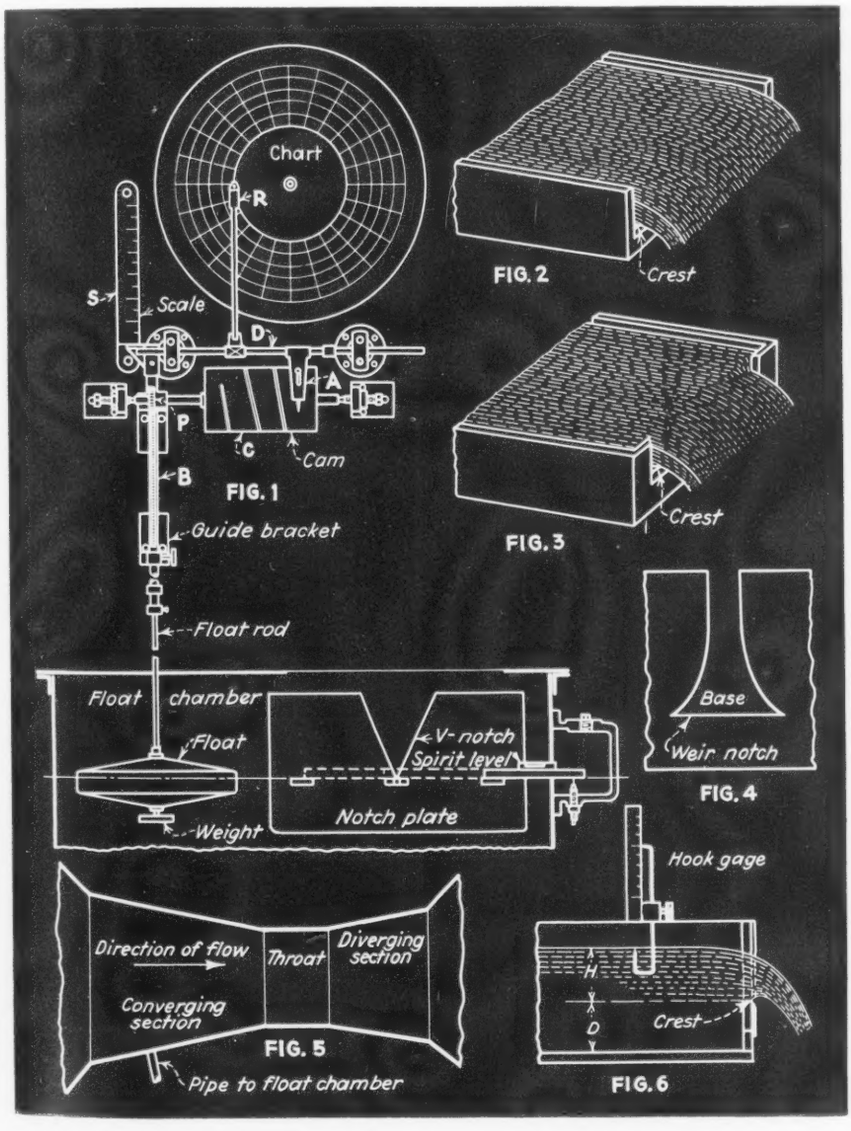


Fig. 1—Meter connected to V-notch weir. Figs. 2, 3—Rectangular-type weirs. Fig. 4—Parabolic weir notch. Fig. 5—Parshall venturi flume. Fig. 6—Cross-section of weir showing how liquid level is measured with hook gage

Head-Meter Installation

▶ WHEN INSTALLING HEAD METERS many factors must be considered to insure accuracy. Manufacturers provide complete instructions on how to install their equipment in service. These should be carefully studied before attempting to install a meter. In the following a general outline will be given of the factors to be considered.

No brief rule can be given for the satisfactory location of the primary element, other than that it should be installed where the greatest available length of straight pipe precedes the element. Fig. 1 shows the influence of some of the conditions that affect the location of the primary element, from a paper by R M Van Duzer, Jr, based on experience in remodeling Conners Creek and Delray steam plants, presented at the 1938 ASME annual meeting. In the figure the ratio of orifice diameter to internal pipe diameter is given as $D_2 \div D_1$. That is, if the pipe has an internal diameter, D_1, of 8 in. and the orifice diameter, D_2 equaled 4, then the ratio of D_2 *to* $D_1 = 4 \div 8 = 0.5$

Straight Pipe Required

The curves are for ratios of 0.1 to 0.7. In the upper left-hand corner the curves are for the minimum length of straight pipe above and below the orifice when a valve is in the line. If the orifice diameter is only one-tenth the pipe diameter, the minimum length of straight pipe M between the orifice and a valve upstream from it is about 13 pipe diameters. For an 8-in. pipe the valve would have to be located not less than 13x8=104 in., or 12 ft 8 in. away from the orifice.

When the orifice is seven-tenths the diameter of the pipe the valve will have to be a minimum distance of 40 pipe-diameters away. On an 8-in. pipe this would be 40x8=320 in. or 26 ft 8 in. of straight pipe. Below the orifice, a valve should not be located less than 5 pipe-diameters away irrespective of the size of the orifice.

As can be seen from the curves, a valve is one of the most disturbing influences that can be put into a pipe line. For a 90-deg elbow in the pipe above the orifice the minimum length M of straight pipe for an orifice ratio of 0.7 is only 15 pipe-diameters compared to 40 for a valve.

Where the requirements for straight length of pipe preceding the orifice or nozzle cannot be met, accurate measurements can be obtained by installing straightening vanes at the entrance to the straight run of pipe. These vanes eliminate the eddies and whirls in the flow caused by pipe fittings, valves or piping layout preceding the primary element.

These vanes may consist of a nest of thin tubes, Fig. 2, or of radial fins, Fig. 3. They are made three pipe-diameters long and are arranged with a flange to be clamped between the pipe flanges at the entrance to the straight run of pipe.

When an orifice plate is to be installed in a flange, remove one half of the bolts, loosen the others and separate the flanges sufficiently to insert the plate between two gaskets. Cut the gaskets to match the outside diameter of the orifice plate and the inside diameter of the pipe. Attach the gaskets to the plate with shellac and cover their exposed surfaces with graphite and oil. This makes it easy to remove the plate if it becomes necessary.

When the orifice plate is installed in a flange make sure that the orifice is concentric with the pipe. The plate should fit snugly between the flange bolts. If it does not, any play must be equalized by placing the outside of the plate concentric with the bolts.

Locate the center of the holes for the pressure taps and drill the holes perpendicular to the axis of the pipe. Use a standard pipe tap, but do not tap so deeply that the ends of the nipples will protrude into the pipe when they are tightened into place. Remove all burrs from the holes on the inside of the pipe with a file.

On steam lines the pressure taps are made into the side of the pipe on a horizontal plane passing through the pipe axis. These taps are provided with reservoirs. Fig. 6 shows a cross-section through one of these reservoirs of

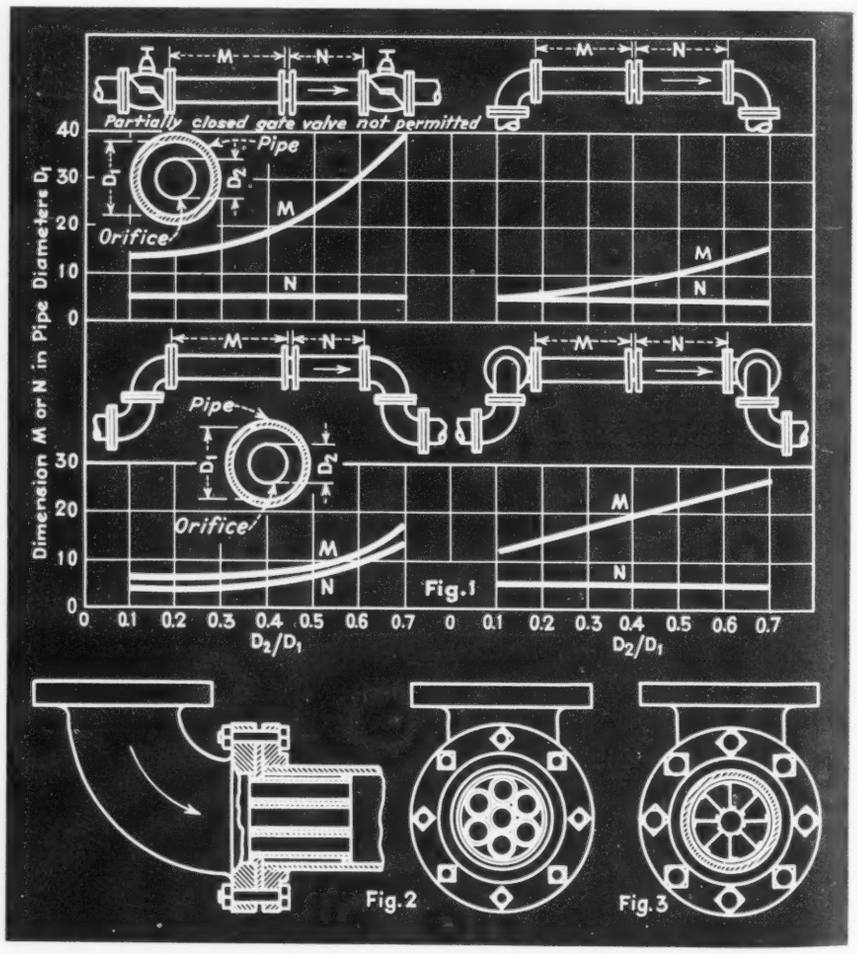


Fig. 1. Curves show minimum length of straight pipe for undisturbed flow without straighteners, for nozzle or orifice-plate installation. Figs. 2, 3—Types of flow-straightening vanes for installation in the entrance to the straight length of pipe

the radiator type. The radiator is omitted on other designs of reservoirs. Steam condenses in these reservoirs to maintain the meter-connecting lines full of water.

The reservoir provides a small storage space at the ends of these lines to take care of evaporation in case the pressure drops below the flash point during rapidly changing flow. An offset in the entrance pipe to the reservoirs insures that the reservoirs will be full of water at all times. Air cocks permit venting air that may settle out of the water in the meter-connecting lines and rise into the reservoir.

Flowmeter Connections

Meters for measuring steam flow are connected to the pipe line as in Figs. 4 and 7. When possible the meter should be installed below the orifice level, as shown in full lines, Fig. 7, so that there will always be a positive head of water on both sides of the manometer in the meter.

When the meter must be placed above the primary element, the piping connections should be made as shown by the dotted lines, Fig. 7, provided the steam pressure is over 10 lb per sq in. and the flow is not pulsating. From the reservoirs the piping drops down a distance equivalent to the maximum differential head that will be on the meter. The piping is then carried vertically to above the meter where its connections to the manometer are provided with two air vents.

Fig. 4 shows the connections to a vertical flow line. In this case the reservoir on the lower tap has been raised so that its center line is on a level with that of the reservoir on the top tap.

Connections for metering clear water are the same as for steam except that the reservoirs on the nipples are omitted. The nipples are not bent when the taps are made in a horizontal pipe.

When steam, water or other fluid being metered contains sediment, which might enter the meter and interfere with its operation, settling chambers are provided in the piping, Fig. 5. The high-pressure-tap connection extends nearly to the bottom of its chamber whereas the low-pressure tap connects to the top of its chamber.

Any sediment entering the lines to the meter settles to the bottom of the chambers where it can be blown off periodically through the bottom connections. To detect any leaks through the blowoff valves that might cause an error in the meter reading, place the open ends of the blowoff pipe where they can be seen readily.

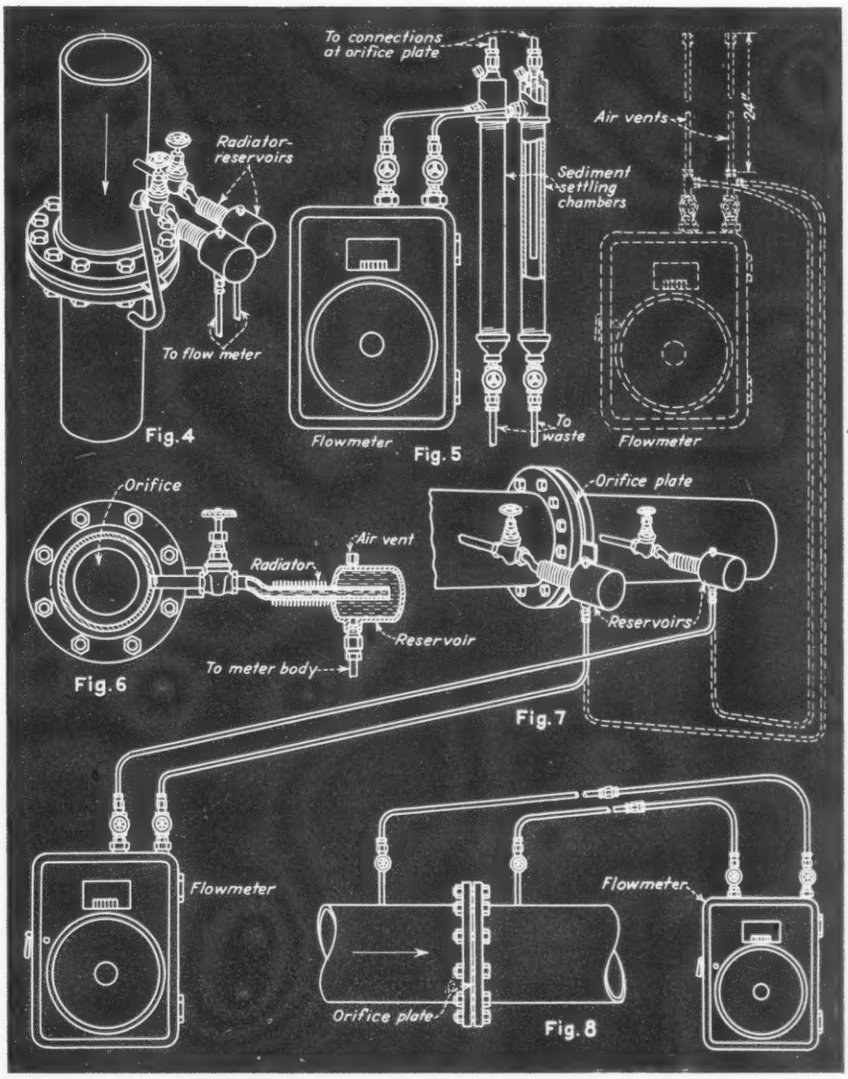


Fig. 4—Flowmeter connections to a vertical steam pipe. Fig. 5—Settling chambers for connection in flowmeter piping when fluid contains sediment. Fig. 6—Cross-section through reservoir on flowmeter pressure taps. Fig. 7—Way to connect flowmeter for steam when the meter is either above or below flow line. Fig. 8—How flowmeter connections are made for either air or gas

For air and gas, meter connections are made as in Fig. 8. The taps are usually made into the top of a horizontal run of pipe, from which the connecting lines extend vertically upward one or two feet before bending toward the meter, to keep the lines free of condensate. It is immaterial whether the meter is mounted above or below the pipeline level.

When the flow is pulsating, such as steam to an engine or water from a reciprocating pump, any head-type flowmeter will read high unless the pulsations are eliminated. Inertia of the mercury or oil in the meter body and the water in the connecting pipes prevents the meter responding correctly to the pulsations.

When the flow cycle is known it is possible to calculate the error, or the meter may be calibrated and a pulsation factor determined, by which the meter reading can be divided to obtain the correct flow. Generally, however, means are installed to reduce the pulsations to where they do not seriously affect metering accuracy.

Flow pulsations are always accompanied by pressure pulsations, so that the oscillations of an undamped pressure gage or manometer serves as an indication of the amplitude of the pulsations. In general when the pulsations are reduced so that the oscillation does not exceed 5% of the static pressure, meter accuracy will be satisfactory.

The foregoing gives a general idea of some of the problems involved in the installation of head meters. Before attempting such a job, secure the manufacturer's instructions. It will be a good idea to have these instructions available all the time and to become thoroughly familiar with them.

Special Methods

► FOR THE GREATER PART, the previous articles described methods of metering flow. Several methods have been developed whereby data can be obtained from which flow in open channels and closed conduits can be calculated. One of these, the weir, described on page 85 is applicable to open-channel measurements only. Among the remaining better known means of measuring flow are the Allen salt-velocity, Gibson, current-meter, pitot-tube, photoflow, and orifice methods and the Annis meter.

The Allen salt-velocity method, developed by Prof C M Allen, Worcester Polytechnic Institute, is an accepted standard for measuring flow in closed conduits when testing waterwheels and large pumps. When using this method a charge of salt solution is injected into the conduit above two sets of electrodes. This solution changes the electrical conductivity of the water and makes it possible to record on electric meters the passage of the solution by the electrodes. Elapsed time required for the solution to pass the two sets of electrodes is also recorded. From the data thus obtained the rate of flow in the conduit can be accurately calculated.

The Gibson method is another accepted standard for measuring water in closed conduits to waterwheels. It was developed by Norman R Gibson, vice president, Buffalo, Niagara & Eastern Power Corp. This method is based on the well-known fact that when flow of fluid in a pipe is stopped by closing a valve a pressure wave results that travels up and down the pipe until it is dissipated. In the Gibson method this wave is recorded on a time base. Such a record looks something like Fig. 1, from which the flow in the pipe, at the time the valve was closed, can be figured.

Current Meters

Current meters are used chiefly to measure flow velocities in open channels. They are also used to measure flow in pipelines and penstocks. One of these meters has a wheel with cup-shaped buckets, Fig. 2, and another is equipped with a propeller, Fig. 3. These meters are so constructed that their wheel turns one revolution per second for each foot per second of current velocity. A method is provided for recording the revolutions of the wheel. In use, the current meter is placed at a number of locations in the stream to get a mean rate of flow. From this record and the cross-sectional area of the stream the flow volume can be calculated.

Pitot tubes, one design of which is shown in Fig. 18, page 73 are used to measure the differential head resulting from flow velocity in pipe lines. Flow in a pipe is at a minimum at the pipe's surface and at a maximum at its center. To get a true measure of the flow velocity in the pipe it is necessary to take measurements across the pipe's diameter and average these to get a mean differential head, from which to calculate the mean rate of flow.

The photoflow method uses several pitot tubes in the cross-sectional area of the pipe. Each pitot tube connects to a glass tube or a graduated board, where the differential head shown by each tube can be photographed simultaneously. In this way a true record of velocity across the pipe is obtained at a given instant, from which the flow is calculated.

The orifice-with-free-discharge method consists of fixing a calibrated plate orifice to the end of a pipe line, such as the discharge from a deepwell pump, and measuring the head on the orifice with a manometer. Fig. 5 shows a cross-section through such an orifice. Nozzles are also used in a similar manner for measuring free discharge from pipe lines. For further details see Hydraulic Institute Standards.

An Annis intake meter consists of an intake nozzle with a piezometer ring around its throat, attached to the intake end of a pipe line such as the suction of a pump, Fig. 4. An inverted U-tube manometer is placed at about the same elevation as the pump. One end of the manometer is connected into the piezometer ring and the other is carried down below the water level with rubber hose. Air is drawn from the manometer top until water rises about one-third the way up its legs. Then when the pump is started the differential head shown by the manometer is a measure of the flow.

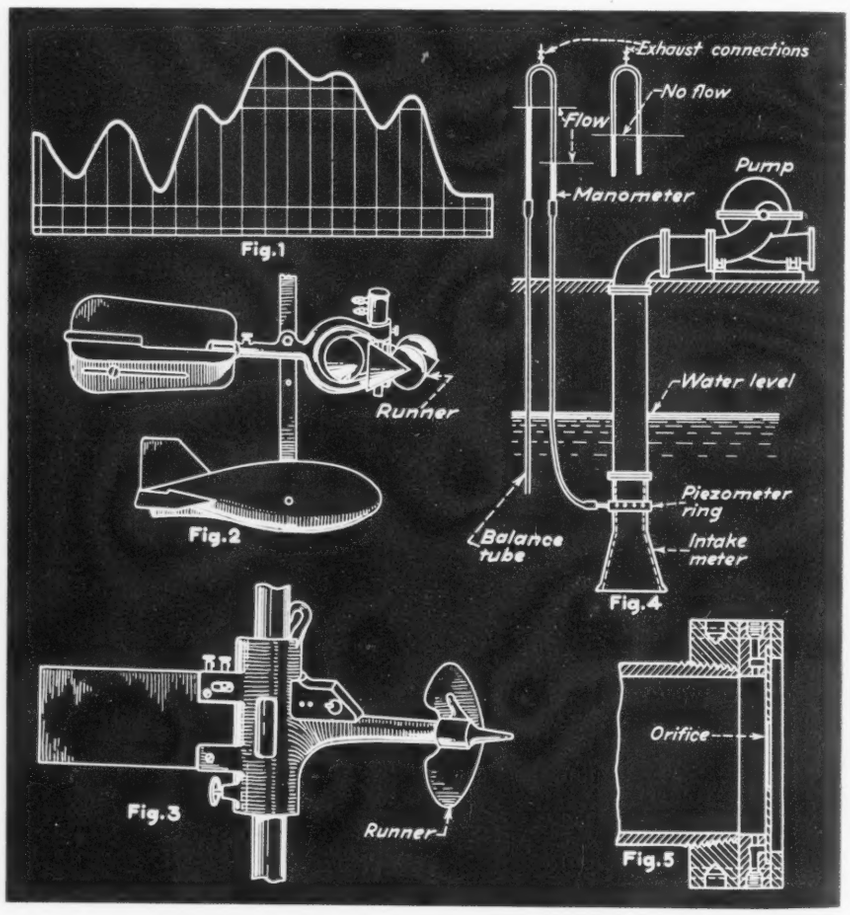


Fig. 1. Pressure-time wave taken by the Gibson apparatus. Fig. 2. Cup current meter. Fig. 3. Propeller current meter. Fig. 4. Annis intake meter. Fig. 5. Cross-section through a standard orifice for measuring free discharge

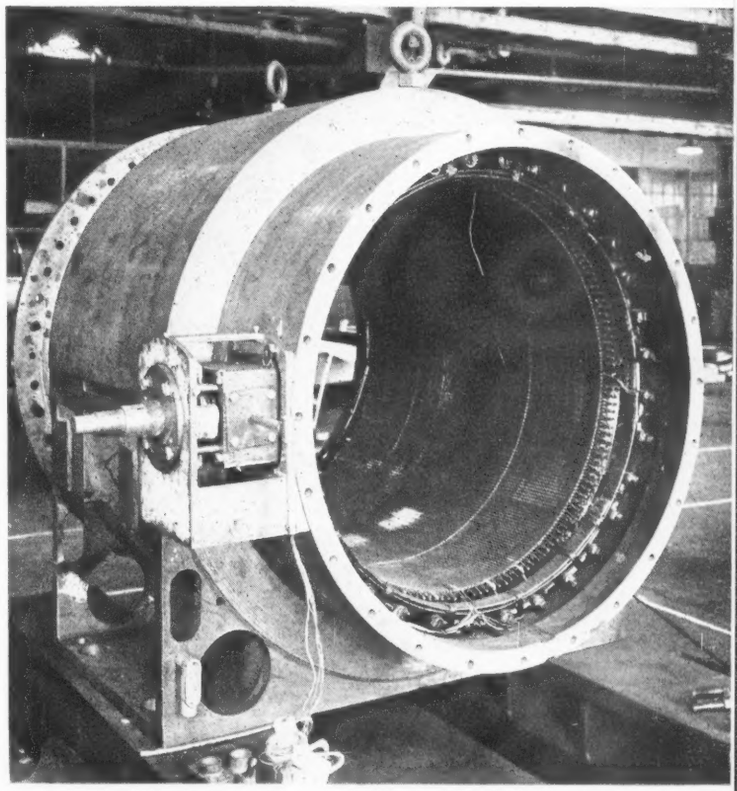
Hydrogen for High-Frequency Cooling

HIGH-FREQUENCY CURRENT for metallurgical applications, heat treating, melting, and heating finds ever increasing use. Power of 1000 kw at 10,000 cycles is now possible, and for power above 100 kw and frequencies up to approximately 10,000 cycles, the inductor type of electromagnetic generator is universally used.

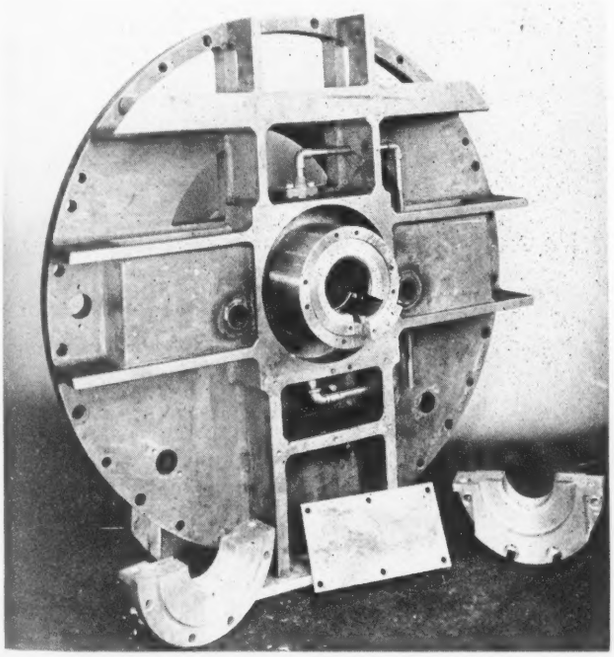
One limitation in the size of these generators is the high windage loss which limits the rotor diameter. With hydrogen cooling these high windage losses are reduced to a fraction of their value, and the efficiency of the machine is considerably improved. Another noticeable result obtained by the use of hydrogen cooling is the marked decrease in the noise, a pronounced characteristic of high-speed generators. Furthermore, sealed enclosures prevent dirt from reaching the windings, and the machine remains permanently clean. This feature is particularly valuable in metallurgical plants where air filters are often found necessary on rotating electric machines.

The following pictures show a 500-kw, 9600-cycle hydrogen-cooled generator in service for more than one year in the plant of Budd Induction Heating, Inc, in Detroit. A similar machine has recently been installed at the Caterpillar Tractor Company, Peoria, Illinois.

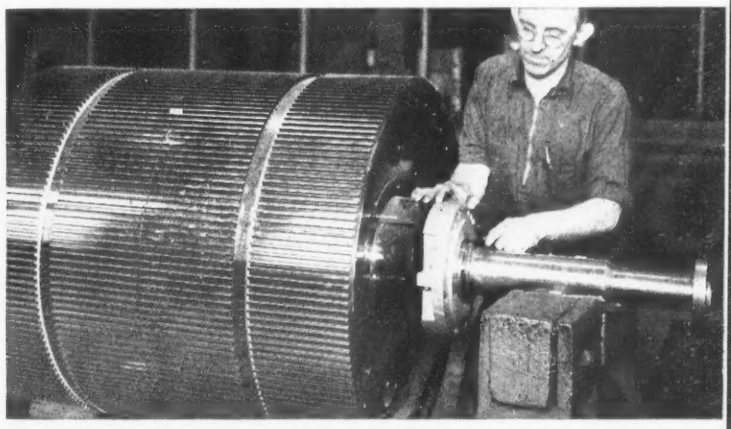
(Continued on Page 92)



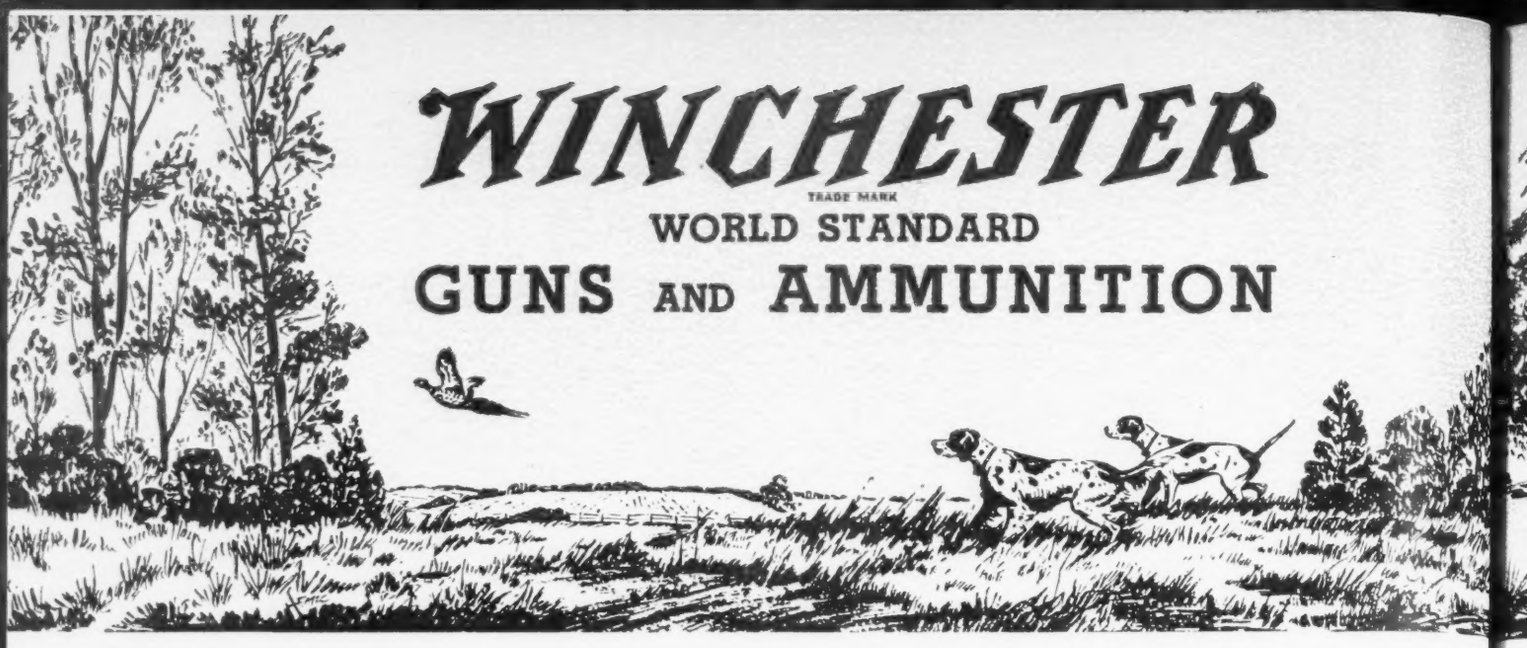
The stator core is built of thin laminations. Because of high-frequency current, large losses are confined to a small volume of material. Water cooling of the core is the most effective means of dissipating stator copper and iron losses. Water cooling is much more effective than air cooling and results in a machine of smaller dimensions. Furthermore, with water cooling no vent ducts are necessary in the core. Since an inductor-type machine has a large number of small coils and stator teeth, a simpler and more rugged construction is obtained when water cooling is used.



Shoe-type bearings operating on the pivoted-pad principle are used in this generator bracket. For generating 10,000 cycles, the poles of the rotor and the air gap must be very small. This means highly accurate machining and alignment in order to reduce the unbalanced magnetic pull to a minimum. With the small air gap for a small displacement of the rotor due to the bearing clearance, this unbalanced magnetic pull is sufficient to overcome the weight of the rotor. The bearings are designed to carry load in any radial direction and can carry a much higher load than conventional bearings.



The rotor of an inductor-type high-frequency generator is simple, rugged, and reliable. It has no collector rings or windings, and can be operated at high peripheral speeds with a consequent reduction in cost, weight, and dimensions. Because of the high peripheral speeds, the rotor is made of high-strength alloy steel. A shrink fit prevents rim from loosening under high operating stresses and temperatures.



RILEY scores another bull's-eye

again Riley performance exceeds guarantees . . .

In 1938, Winchester Repeating Arms Company placed into operation two 75,000 pounds of steam per hour Riley pulverized coal fired steam generating units. Because of the excellent and completely satisfactory performance of these units, when increased defense loads required installation of additional capacity, a new 100,000 pound per hour Riley Unit was selected without competition.

If you were to investigate—and we recommend that you do so if you are considering the installation of steam generating units—the performance of the Riley Units at Winchester, you would surely agree that Riley has scored another bull's-eye.

The new 100,000 pound per hour unit is operating at an efficiency of 88.56% against a guaranteed efficiency of 86.5%—a bonus of 2.06%. All three units have operated at capacities appreciably in excess of guaranteed capacities. Pulverizer power consumption is 14.8% less than guaranteed.

Such performance is all the more remarkable when it is considered that this outstanding performance was obtained from the time the units were first placed on the line. It was not necessary to make changes to bring about the results. The ease and smoothness with which these units were placed on the line is characteristic of Riley Units.

August 5 — Units brought up to pressure.
August 13 — Brought to full load.
Sept. 24 — Acceptance test conducted.

So with characteristic ease, another Riley "RP" Unit was placed into satisfactory operation. It is because of the extraordinary performance of Riley Units that "It will pay you to visit modern, Riley installations before purchasing boiler or fuel burning equipment."

A Partial List of Other Repeat Orders for Riley Steam Generating Units

Allis Chalmers Mfg. Co.
American Brass Co.
Standard Oil Co. of Calif.
Bullard Company
Carbide & Carbon Chem. Corp.
General Motors Corp.
Masonite Corp.
Pet Milk Company
Curtiss Wright Corp.
Scovill Manufacturing Co.
Western Cartridge Co.
Central Illinois Light Co.
Humble Oil & Refining Co.
St. Croix Paper Co.
Norton Company
Imperial Color & Paper Co.
Union Electric Company
Celanese Corp. of America
U. S. Gypsum Co.
Shell Oil Company
Revere Copper & Brass Co.
Swift & Co.
Mead Corporation
Dow Chemical Co.
Houston Lighting & Power Co.
Central Ohio Lt. & Power Co.
Container Corporation
Great Western Sugar Co.
City of Los Angeles
Modine Mfg. Co.
Republic Creosoting Co.
General Aniline Works
Natrona Light & Power Co.

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Seattle Baltimore Portland Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

If practice makes perfect, 17 million shots should make a world's champion. They were fired during the past fifty-two years by a rifle tester in the New Haven plant of the Winchester Repeating Arms Co. Result: some 2,500,000 rifles tested and approved—some shooting record.

at WINCHESTER

facts about the performance of Riley "RP" Units at Winchester Repeating Arms.

Actual Efficiency—88.56%
Guaranteed Efficiency—86.5%
Actual Capacity Carried—130,000 lbs. per hour
Guaranteed Capacity—125,000 lbs. per hour

Actual Efficiency—87.4%
Guaranteed Efficiency—86.5%
Actual Maximum Capacity—90,000 lbs. per hour
Guaranteed Maximum Capacity — 75,000 lbs. per hour
Actual Power Consumption, Pulverizers, when pulverizing 5,000 lbs./hr.—10.6 K.W./ton.
Guaranteed Power Consumption—12.44 K.W./ton
Steam Pressure—725 lbs. Steam Temperature 750° F.
Unit consists of Riley boiler, superheater, water-cooled furnace, air heater and steel-clad insulated setting fired by Riley Pulverizer and Burner

●

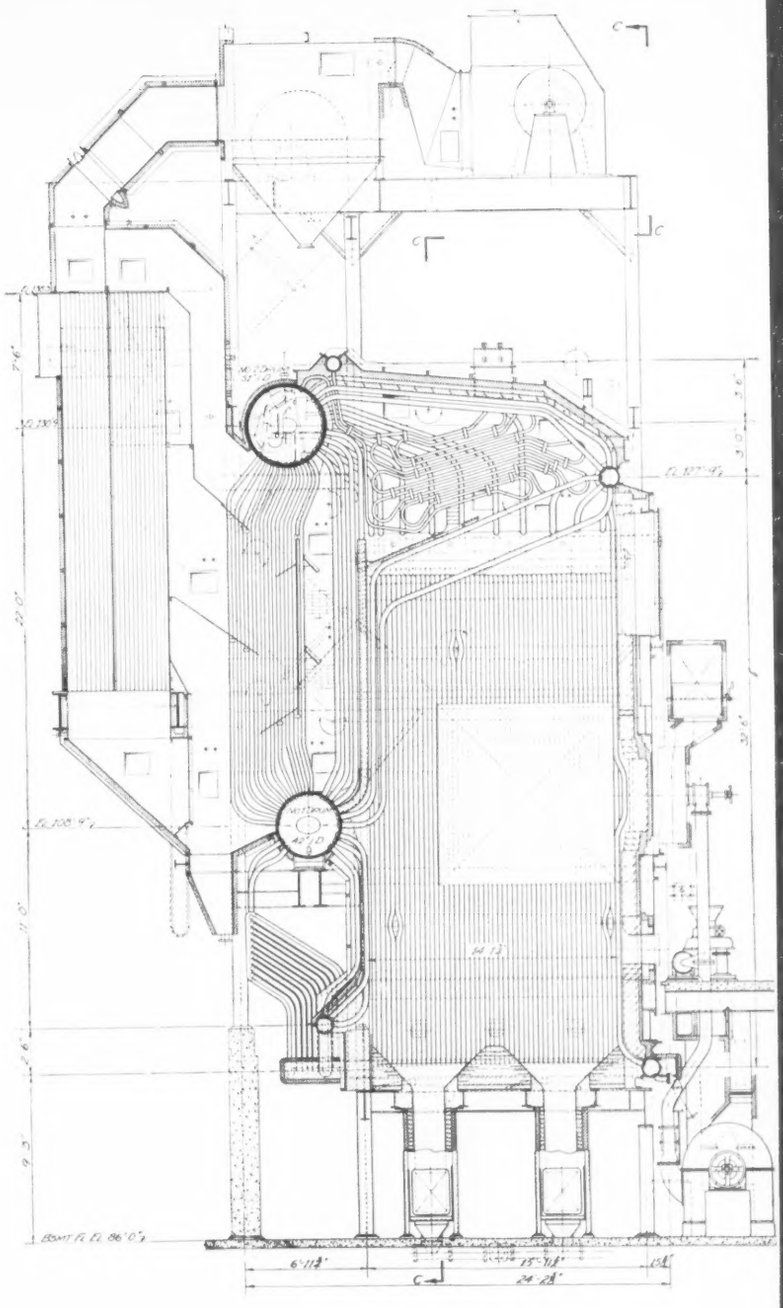
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

●

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS

COMPLETE STEAM GENERATING UNITS

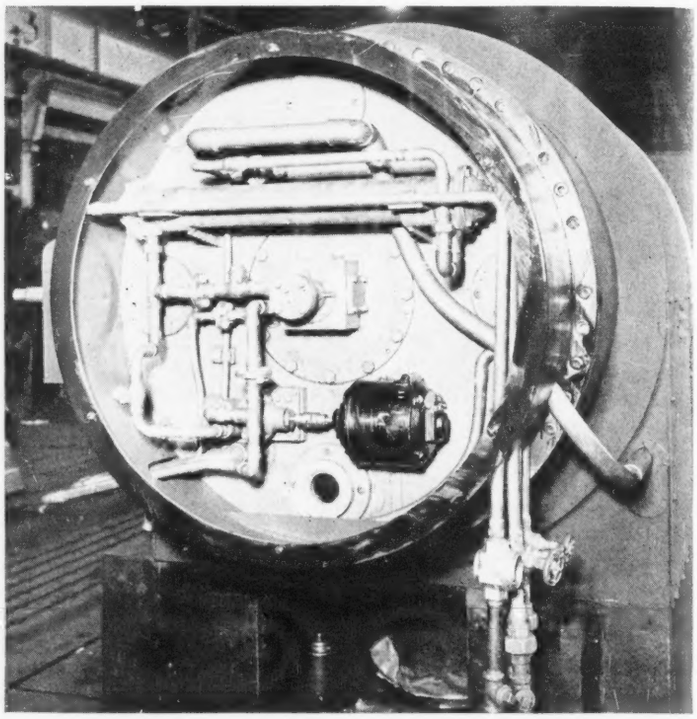
AIR HEATERS • ECONOMIZERS • WATER-COOLED FURNACES
STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS



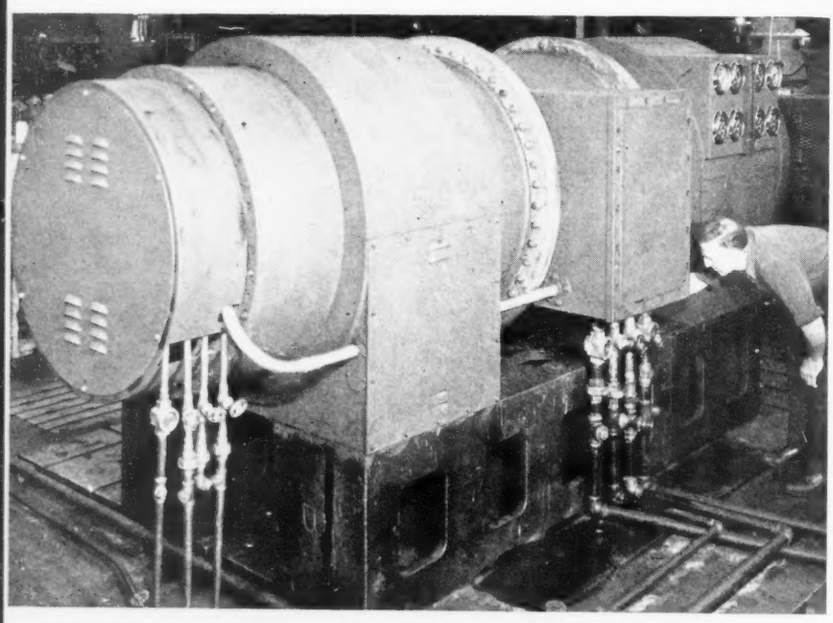
before purchasing Boiler or Fuel Burning Equipment

Hydrogen for High-Frequency Cooling

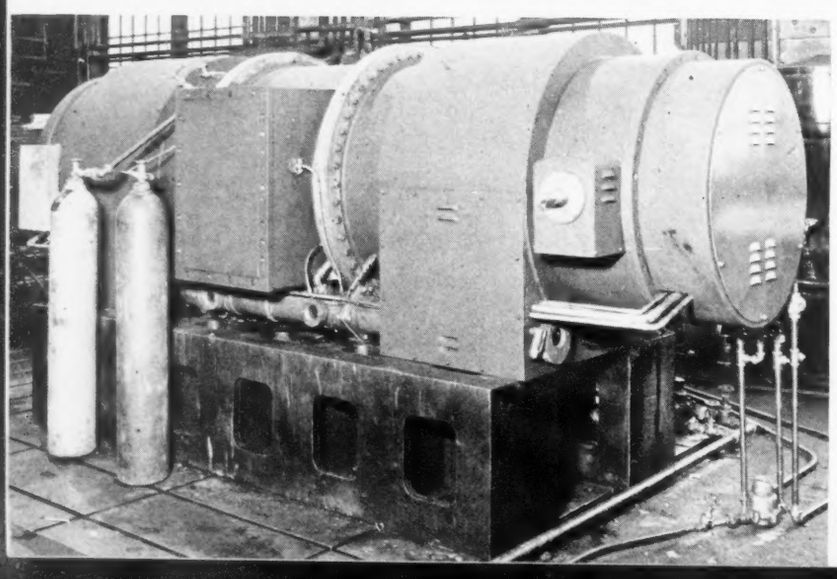
(Continued from page 89)



Bearings are pressure lubricated by this high-speed oil pump direct-connected to the main shaft. A motor-driven pump supplies oil and primes the direct-drive pump during the starting period, and the oil is cooled by means of a water cooler. All this equipment is mounted on the generator bearing bracket. The oil reservoir is made of a long steel pipe mounted inside the feet of the generator and motor stators. A sight window placed at the side of the reservoir makes it possible to observe the oil level and the flow of oil through each bearing.



Front view of the frequency-changer set. The lubricating system is enclosed by a circular housing at the left. Inside the rectangular door in the center are the gas water coolers which can be removed sideways. When these coolers are removed the center bearings are accessible for dismantling. Control valves located under the housing regulate flow of water to the cooling pipes of the generator stator and the gas coolers. The squirrel-cage motor is located in the far end. Especially designed for this application, the full-load slip of this motor is a fraction of one per cent, thus keeping to a minimum variation in frequency of the generator from no load to full load. The motor was also designed to withstand the severe starting conditions resulting from the relatively large flywheel effect of the generator rotor. The control instruments are: Four bearing-temperature indicators, two gas-temperature indicators, one oil-pressure gage, one gas-pressure gage, one U-tube pressure-gage connected across the motor blower. This tube indicates the density of the gas mixture when the machine is running. The density of the gas mixture is positive indication of the amount of air in the hydrogen used to cool the machine.



Rear view of set. The gas-tight lead connections of the motor and generator are seen on the horizontal centerline. The complete gas control of the machine consists of four valves as follows: 1. At the bottom of the motor stator, feeding carbon-dioxide when scavenging the machine of air or hydrogen. 2. At the top of the machine, regulating hydrogen intake. The gas consumption of this machine is quite low. One bottle of hydrogen should last one or two weeks depending upon the gas pressure kept in the machine. 3. At the top of the generator frame, for removing air or hydrogen when scavenging with carbon dioxide. 4. At the bottom of the frame, for removing carbon dioxide when the machine is being filled.

WARTIME POWER CLINIC

Practical ways to create emergency capacity. Cures for overloads, breakdowns, short-handed staffs, lack of spare parts, etc. Contributions invited at regular rates

This is Your Department

By PHIL SWAIN

HERE'S A BRAND NEW SERVICE DEPARTMENT, designed to run every month as long as the national emergency demands. This "Clinic" will be a place where the engineers responsible for America's power facilities, both industrial and utility, can swap experiences concerning wartime power troubles, their cure and their prevention.

By "wartime troubles" we mean that whole brood hatched out of the flood of work in war-production plants and the resulting dislocations of loads, workers, hours and materials. These troubles came on us gradually as "defense" expanded, and will now be redoubled.

More and more frequent will be the complaints that electrical, steam, mechanical and water facilities are overloaded—that machines are working 24-hour days and 7-day weeks without proper standby—that repair parts and materials are unobtainable—that there is no time for maintenance—also that the good maintenance men are leaving for the Army or Navy, or are being "stolen away" for jobs in other manufacturing plants.

These things are happening everywhere, yet power engineers dare not use them as an excuse for failure to supply essential services. The men in charge of operation and maintenance *must* keep wheels turning.

In times like these cooperation becomes a patriotic duty, as well as a private virtue. The engineers who have found ways to cure or prevent such troubles will want to pass them along to fellow sufferers in other plants.

This "Clinic" is made to order for that purpose. If you have worked out a practical cure for some war trouble in your own plant write it down briefly and send it in. Include sketches or photos where possible. Material published will be paid for at regular rates.

Or perhaps you have a problem of this sort you can't answer. Send it in for publication if the answer would be of practical interest to other engineers.

To get going without delay on this first edition of our Wartime Power Clinic, two of the editors (Feller and Swain) drove through the busy war-production cities of nearby Connecticut and dug up the following items. In another month or two, with your help, this department will expand to a truly national scope.

Let's Guard Against Interruptions

HERE ARE SOME WARTIME SUGGESTIONS for utilities, industrials and cities: Both industrials and central stations should immediately seek an auxiliary water supply (to be obtained by sinking artesian wells, or by other means) to insure makeup and service water if city-water supply should fail through sabotage or otherwise. Likewise, city water departments and utilities, with the assistance of state and local governments, should equip some old trucks with tanks to transport drinking water to homes and institutions in emergencies. The tanks must be well baffled; otherwise surging water may upset trucks.

In certain cases the lowering of city water pressure through damage to the mains may be almost as serious as complete loss of water, if the utility (or industrial) is depending on city pressure to lift the supply water to an elevated tank. Right now Wescott and Mapes is designing a system wherein a booster pump will automatically cut in when the city pressure falls below a certain level. This will insure essential water for fan bearings, seal-water tanks, etc. Many plants should install such protection.

Every utility and industrial should proceed at once to install enough emergency power capacity to insure operation of minimum general power-plant lighting and of electrically powered controls. Nothing fancy is needed; an automobile engine might be used to drive an ac generator. Chief difficulty will be getting voltage regulators. The plant crews must be drilled in starting and running these sets.

Utilities and industrials with widely spread operations should buy or assemble portable power plants mounted on trucks. In general, these plants should be gasoline-engine driven. The ideal outfit is the army power truck, probably not obtainable by industry (but it can be imitated). To handle all types of emergencies such trucks could be rigged not only to generate electricity, but also to drill holes, saw wood, grind tools, thread and weld pipe, and so on. Portable power plants would be invaluable for the emergency operation of broadcasting stations, hospitals, telephone plants, etc.

Power failure in a factory may damage equipment as well as delay production. For example, many factories are warmed by unit heaters and other types of fan-circulating heating systems. In cold weather electric service must be maintained to the fan motors of these heaters. Otherwise the fire sprinkler system and water piping may freeze, even with steam in the coils.

New Haven, Conn.

W F THOMPSON
Mechanical Engr.
Westcott & Mapes, Inc

Emergency Fan Coupling

ON THE LATEST BOILER UNIT of the Scovill Manufacturing Co, duplex induced- and forced-draft fans are driven through herringbone gears by a 635-hp steam turbine. There is one flexible coupling between the turbine and the pinion, and another of the same type between the gear and the fans (see diagram 1).

Sketch 2 shows the rough outline of the coupling. This is an internal-and-external gear-tooth unit. The casing consists of two halves bolted together, each half having small-pitch internal gear teeth. Meshing with the internal teeth are the external teeth of two gears. In the case of the first-named coupling, one of these gears is shrunk and keyed to the turbine shaft and the other to the pinion shaft. The casing is full floating. Thus the turbine shaft drives the casing, which in turn drives the pinion shaft.

Service on this high-speed turbine-end coupling is particularly severe because the turbine shaft shifts its position as the machine warms up. Unsuitable lubricating oil in the coupling, subjected to high temperature of turbine shaft, congealed, stripping the teeth on the pinion side. A new coupling of the same type was ordered for delivery "as soon as possible" and work on a temporary repair was started at once. The idea was to make two heavy clamps, bolting the large *driver* clamp to the pinion-end hub of the coupling casing, and the smaller *driven* clamp to the adjacent pinion shaft, as shown in 2 and 3.

The four driving fingers, projecting from the driving coupling, enclosed the ends of the driven coupling. Normally only two of these fingers are working. With a backlash of $\frac{1}{32}$ inch, the other two keep the improvised coupling from running wild when the turbine is shut down, or when its speed is suddenly reduced by the automatic combustion control.

All this was the plan, at least. The newly ordered coupling arrived just as this emergency coupling was completed. The latter will be kept in stock as a temporary repair part. It should be noted that the two clamps, after machining, were mounted on a dummy shaft and hub and thus balanced on knife edges to avoid vibration in operation. Two set screws in each clamp prevent slipping.

Waterbury, Conn. A J GERMAN
Chief Engineer, Scovill Mfg Co

Compressor Operates on H-P Steam in L-P Cylinder

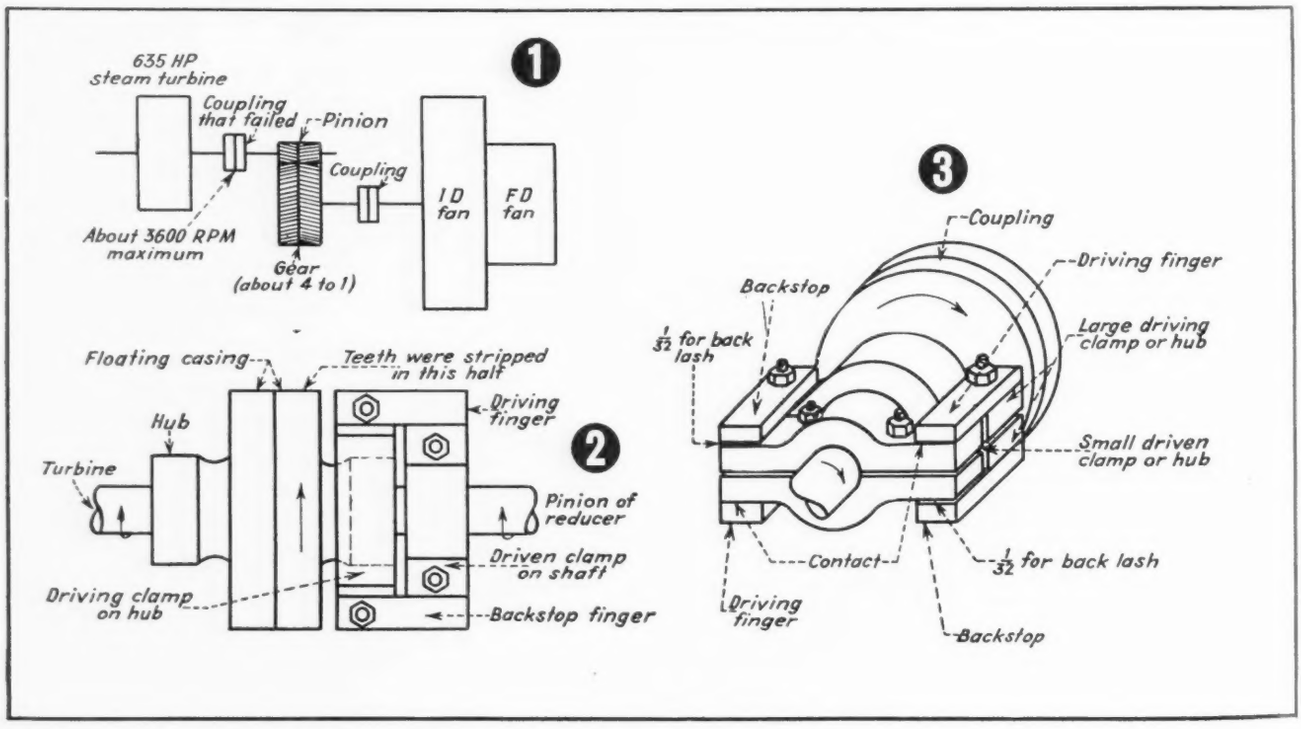
HERE'S ANOTHER SCOVILL EMERGENCY repair job (see previous item). This metal-working plant has been heavily loaded with defense work for nearly two years. Demand for compressed air has risen even faster than electric-power demand has increased.

A few months back, at a time of peak compressed-air requirements, the high-pressure steam-cylinder valve gear failed on an old 2200-cfm compressor. Our emergency repairs permitted operating the low-pressure cylinder with throttled high-pressure steam. The compressor ran that way for six weeks until a new valve gear could be installed. This whole operation was decidedly out of the ordinary and deserves an explanation for the benefit of other compressed-air users.

As shown in Fig. 4, this old-time compressor is a straight-tandem-compound, two-stage compressor with a Meyer "riding cutoff" on the high-pressure steam cylinder. The corliss gear on the low-pressure steam cylinder is not visible in drawing (located on far side). The machine was operating at 90 rpm, 125-lb steam pressure and 25-26-in. vacuum when the high-pressure valve gear failed.

Hasty calculations indicated that the l-p heads should safely stand 50-lb pressure, so we arranged to supply the h-p steam directly to the l-p cylinder, proceeding as follows:

We lifted the cover plate of the h-p steam chest and removed the main slide valve and riding cutoff, complete with their respective valve stems. The stem gland openings were sealed with blank flanges and gaskets. We left the h-p piston in place. When the chest cover was replaced and the steam cautiously read-



Emergency coupling: 1. Coupling that failed. 2. Clamp on casing hub drives clamp on pinion shaft through projecting fingers. 3. Same as 2, in perspective. Shows backstop fingers to keep coupling under control when turbine is stopped or slowed down

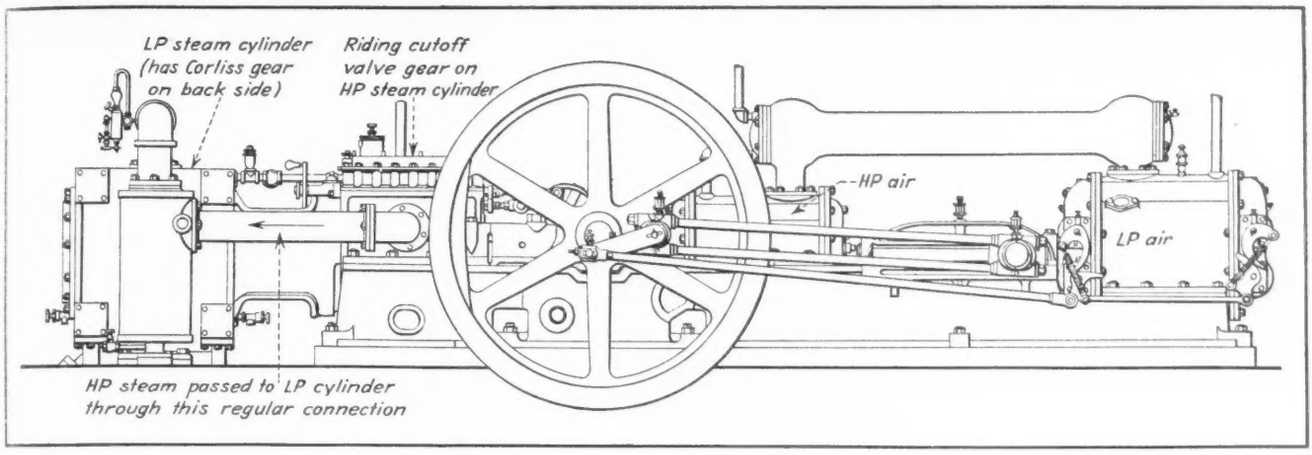

LP steam cylinder (has Corliss gear on back side)
Riding cutoff valve gear on HP steam cylinder
HP air
LP air
HP steam passed to LP cylinder through this regular connection

Fig. 4. Removed h-p steam-cylinder gear and thus passed h-p steam (throttled) directly to l-p cylinder. Ran this way 6 weeks

mitted, the steam pressure acted equally at all times on both sides of h-p piston (which was therefore balanced). The same pressure was immediately transferred to the inlet valves of the l-p cylinder through the normal steam connection (noted on sketch).

We had attached a steam gage to the receiver. After the compressor was up to speed we adjusted the machine to 70 rpm and 50-lb steam pressure and operated this way for six weeks as already indicated.

That air means a lot to Scovill operations is evident from the fact that our plant now operates 12,000 cfm of compressors and expects shortly to add 5400 cfm in a single 1000-hp unit.

Waterbury, Conn. A J GERMAN
Chief Engineer, Scovill Mfg Co

Cure for Hot Motor-Generator Sets

LONG ACCUSTOMED TO HEAVY DEFENSE production, the Bridgeport Brass Co has had to face problems of power capacity. The limitation has been that of its power-converting or power-consuming equipment, rather than that of power supply. We buy power from the local utility, and there has been no question of shortage of supply at any time.

One limitation, first encountered in the hot weather of last summer, was the thermal overloading of our large motor-generator sets. For precise speed control the sheet-brass rolling mills are driven by 250-volt direct-current motors. Alternating current (6900 volts, 3 phase) is converted to dc in three 1000-kw mg sets installed in a room 70x28x20 ft high.

The overheating at heavy loads occurred last summer despite room ventilation by 30,000 to 35,000 cfm of outside air delivered to the room by fans and then allowed to escape through the windows. Whenever the outside temperature exceeded 90 F, that in the room rose to 115 or even 120 F. This high ambient temperature, plus peak loading of the sets, tripped the thermal overload relays several times.

In spite of war loads, this situation won't be repeated next summer because we are now installing a fin-tube cooler to keep the room temperature below 100 F at all times. Fans (size not yet determined) will force air through the cooler into the room. Arrangements will be such that inlet of fan can be supplied with either outside air or recirculated air, whichever is cooler.

The brass plant requires large amounts of city water for quenching and other process uses. Its final temperature is immaterial, so this water will be passed through the cooler before delivery to process.

Bridgeport, Conn.

B G FORBES and J D BROWN
Elect and Struct Engineers
Bridgeport Brass Co

Can You Solve These Problems?

SOME OF THE PLANTS the editors visited in Connecticut had problems their engineers can't answer. For example, a certain metal-working plant is 100% busy on war work. Long before war was declared this establishment was on a 7-day, 24-hour basis. The engineer and plant electrician say they are up against it in a number of respects. Perhaps some reader can help out by sending suggestion for us to pass along.

First is the matter of priorities. Their repair parts carry an A-10 priority, which doesn't get the stuff, as many other plants have discovered. Most painful lacks are electrical relays, ball and sleeve bearings. Here's a sample of bearing experience: A ball bearing wore out and could not be replaced. The engineer machined a replacement sleeve bearing out of cast iron; it lasted one week. Then he made another of brass; that lasted two weeks. The engineer is wondering whether he must go on making a new brass sleeve every two weeks for the duration of the war. And what about lost production every time a bearing is replaced?

A pyrometer-operated relay is badly needed to control the supply of power to a small electric non-ferrous melting furnace. The furnace is out of operation because a relay ordered weeks ago has not been delivered (in a case like this couldn't the engineer "roll his own" from junk parts?—*Editor*)

The engineer says he is having a hard time getting much-needed bronze bearings and bushings. (Why not rig up a small air-blast gas-fired melting furnace, remelt some of the junk brass in the plant and cast his own bushings? —*Editor*)

Finally the engineer says he is losing good maintenance men to the Army and Navy. What to do?

(Readers who have practical answers to these questions are invited to send them in—*Editor*)

PHIL SWAIN,
Editor of POWER

Convenient Colorimetric Test for Phosphates

By GEORGE A JOHNS
Chemist, Barclay Chemical Co, Inc, Cambridge, Mass.

This article suggests a procedure new to the power field, showing how to mix solutions and run the test

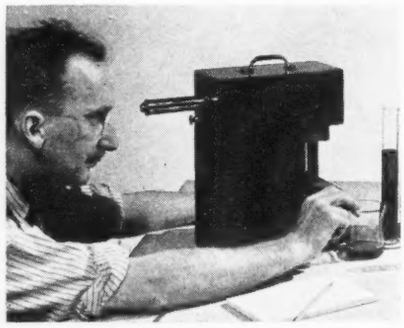
▶ ADVANCEMENT in water conditioning, with higher ratings and pressures, has required a corresponding development of analytical methods and the refinement of control procedure. Because the concentration of chemicals in boiler water is low, and few boiler-room men are chemists, the need for simple and rapid analytical methods is evident.

The determination of phosphates in boiler water has been the subject of much research in both theoretical and applied chemistry. The methods used may be classified as gravimetric, volumetric, colorimetric and combinations of two or more of these.

The gravimetric method, where the volume of the separated phosphate is measured in a graduated tube, has wide application. Its disadvantages lie in the incompleteness of separation of the phosphate as the molybdate salt, especially since it is very difficult to obtain all the phosphate that has not become contaminated. The pH value of the sample, the concentrations of reacting substances, the temperature at which reaction takes place, and the time allowed for the precipitate to settle, must all be controlled if any degree of accuracy is to be obtained.

A centrifuge would undoubtedly speed precipitation, but the result would still be open to considerable error. Moreover, the operator may run into serious error because of a tendency to hurry the procedure.

Phosphate concentration in boiler water seldom runs very high in comparison with the concentration of other salts present. That is why colorimetric methods can be used for accurate phosphate determinations. However, two of the older colorimetric methods (stannous chloride and hydroquinone) can be discarded. Phosphate determination by the reduction of ammoniumphosphomolybdate with stannous chloride is susceptible to gross errors from interfering ions, particularly silica. This



Any type colorimeter may be used. Illustrated is one developed by the author

is also true of the hydroquinone method, with the added disadvantage that the color development is slow.

The use of 1-2-4 aminonaphtholsulphonic acid has won favor in the field of biological chemistry[1] and its application to boiler-water analysis does not differ greatly in procedure.[2] Although this method gives excellent results with rapid color development, the intensity of the color will not be constant if there are any salts that interfere with color developments. This is especially true of iron. In referee work this limitation is useful, because the operator is warned by any change in color or color density. However, in everyday work this change is of doubtful value.

The writer makes use of p-methylaminophenol sulphate for the reduction of ammonium phosphomolybdate. This method can be used with any colorimeter or series of standards. It is rapid and accurate and requires a minimum of time for the determination of soluble phosphate in boiler water. The interference from silica, chloride, sulphate, carbonate, and hydrate is negligible. The color stability is remarkably good. With a good colorimeter the error can be held within one percent with a concentration of phosphate as low as 10 ppm in the presence of silica concentrations as high as 1000 ppm.

A general outline of the procedure will serve to indicate the simplicity of the method. To a 35-ml (milliliter) sample of filtered boiler water add 10 ml of molybdate solution. Mix and add 5 ml p-methylaminophenol sulphate. After five minutes 25 ml of the acetate solution is added for color stabilization; a portion is used for the determination depending on the type of colorimeter used. A series of standards can be made and will give good results for control work. These are prepared as follows: to five test tubes add 6, 8, 10, 12 and 14 ml respectively, of phosphate solution B. Dilute these to 35 ml and treat in the same manner as the sample. These will give readings from 30 to 70 ppm in steps of ten. Should the color lie between any two standards, take the average of these two.

[1] Fisk and Subbarow—Jour. Biol Chem —1925—pp 37?-450
[2] Partridge and Schroeder—ASME Publ —1933

PREPARATION OF REAGENTS

10 normal sulphuric acid	To 650 ml distilled water add slowly, with constant stirring, 225 ml con CP sulphuric acid.
Ammonium molybdate	Dissolve 75 grams of ammonium molybdate in 500 ml 10 normal sulphuric acid; cool to room temp and dilute to 1 liter
Sodium acetate solution	Dissolve 200 grams sodium hydroxide in 1 liter water. Cool to room temp. Neutralize with acetic acid, and dilute to 2 liters.
p—Methylaminophenol sulphate	0.2 grams of this reagent (obtained from Eastman Kodak) dissolved in a solution made with 150 grams sodium bisulphite ($NaHSO_3$) and 6 grams sodium sulphite (Na_2SO_3) in 500 ml distilled water. Dissolve the p-methylaminophenol sulphate by shaking. Filter and store in well-stoppered dark bottle.
Standard phosphate solutions	Solution A—Dissolve 2.609 grams of potassium dihydrogen phosphate (KH_2PO_4) in 100 ml distilled water. Solution B—Dilute 1 ml of solution A to 100 ml. Each ml of this will be equal to 5 parts per million of PO_4 radical when diluted to 35 ml.

THE OPERATING ENGINEER

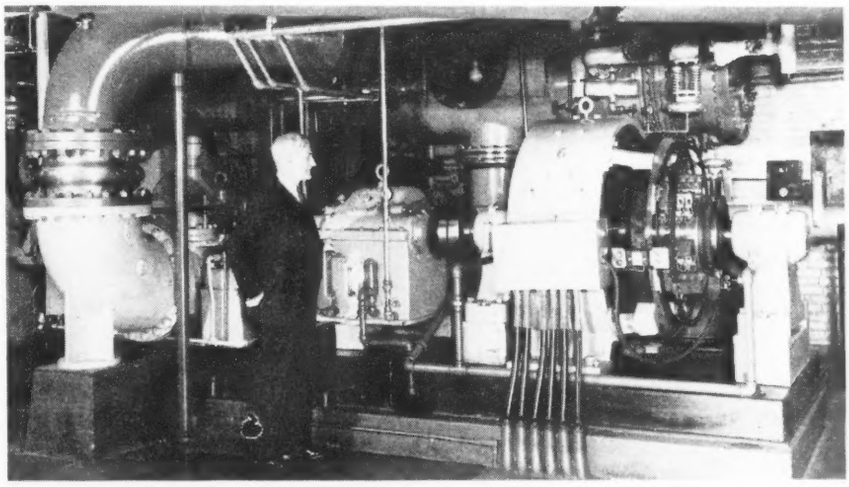
George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

Low-Pressure Condensing Turbine Serves Dual Purpose

When more power-generating and boiler capacity were required in a building power plant, a 300-kw condensing-turbine-driven generator utilizing excess exhaust steam from engines solved both the steam and the power problems



Chief engineer Dobbie apparently is thinking about the kilowatt-hours that his new 300-kw turbine generator produces cheaply from exhaust steam

▶ THE BUILDING at 415 5th Ave, New York City, owned and operated by the 415 5th Ave Co, Inc, represents the transition of 5th Ave from an aristocratic residential street to a business thoroughfare. For many years this building was the home of the well-known Bonwit-Teller department store, which in 1930 moved farther up the avenue. Since then the old store and an adjacent building on 38th St and another on 37th St have been developed into a large manufacturing center, with stores on the ground floor. A power plant in the sub-basement of the old store heats the center and supplies the tenants with steam and power for manufacturing purposes.

Plant Modernization

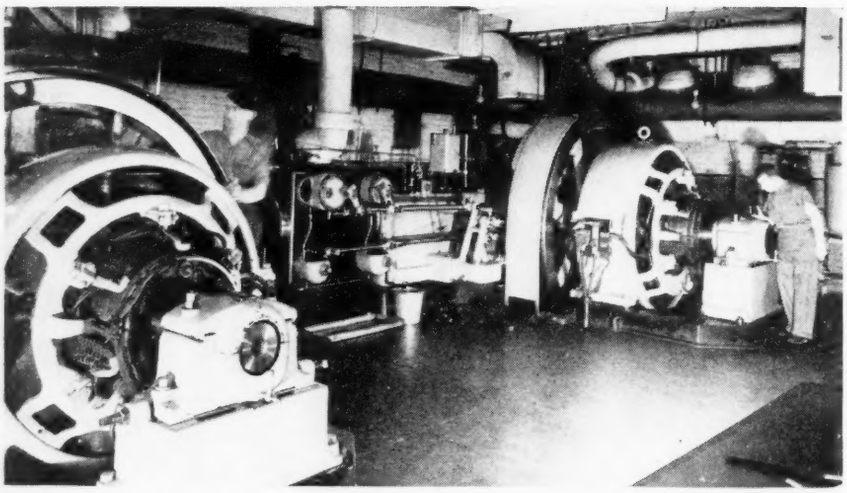
This plant, which is now 31 years old, has been expanded and modernized to meet changing conditions and demands for reliable service. In 1938 it contained two 3000-sq-ft oil-fired water-tube boilers, one 2250-sq-ft oil-fired hrt boiler and two 2250-sq-ft coal-fired hrt boilers, the latter two being used for standby service only. All boilers operate at 130 lb saturated. Power-generating equipment included two 225-kw, two 150-kw and one 125-kw high-speed engine-driven, 120- and 240-volt 3-wire direct-current generators.

At that time the plant was producing over 100,000,000 lb of steam and generating about 1,750,000 kwhr per year. The power and steam demands loaded the power-generating equipment and oil-fired boilers to their safe operating capacity. Kaiser, Muller & Davies, consulting engineers, were retained to make a complete survey of the power and steam requirements and the most economical way to provide for future needs.

Even though the plant was nearly 30 years old it was in excellent condition and meeting the load requirements with 100% reliability. However, the low settings of the boilers prevented operating them above 140% normal rating. The anticipated electric load increase would require the three oil-fired boilers in service operating at 170 to 180% normal rating. Future load increases were estimated to be about 180 kw in winter and 400 kw in summer, resulting from higher lighting intensities, new office and store tenants and new air-conditioning equipment.

Several suggestions had been made to the building owner on the best way to take care of future power and steam demands. These included scrapping the plant and purchasing all power and steam, installation of a modern steam-generating unit or diesel engine.

A study by the engineers of hourly power and steam demands for the two previous years, and of estimated future requirements, showed that the most eco-



The steam engines exhaust into a header against 2-lb backpressure, where the turbine takes steam and expands down to 27-in. vacuum

nomical as well as the most practical solution was the installation of a low-pressure steam-turbine-driven generator, operating condensing with a cooling tower on the roof.

Because of the large amount of heat supplied from manufacturing processes, the amount of steam required for building heating is comparatively small. It was therefore found that there was sufficient exhaust steam from the engines from 8:30 am to 6 pm, 275 days per year, to operate a 475-hp turbine at pressures varying from 1.5 to 2.5 lb gage. This turbine would drive a 300-kw generator supplying a load of from 200 to 280 kw, which would be equivalent to about 650,000 kwhr pr year. Operation of the turbine outside this period would produce another 100,000 kwhr, making a total of 750,000 kwhr generated from exhaust steam. Allowing for turbine auxiliaries, the net power available from exhaust steam would be about 650,000 kwhr.

The low-pressure turbine would serve a dual purpose: First, it would provide ample power-generating capacity, with a safe margin, to take care of the anticipated load increase. Using the exhaust steam for power generation would reduce the demands for high-pressure steam to where the oil-fired boilers could take care of future high-pressure-steam requirements efficiently with a safe margin of steaming capacity.

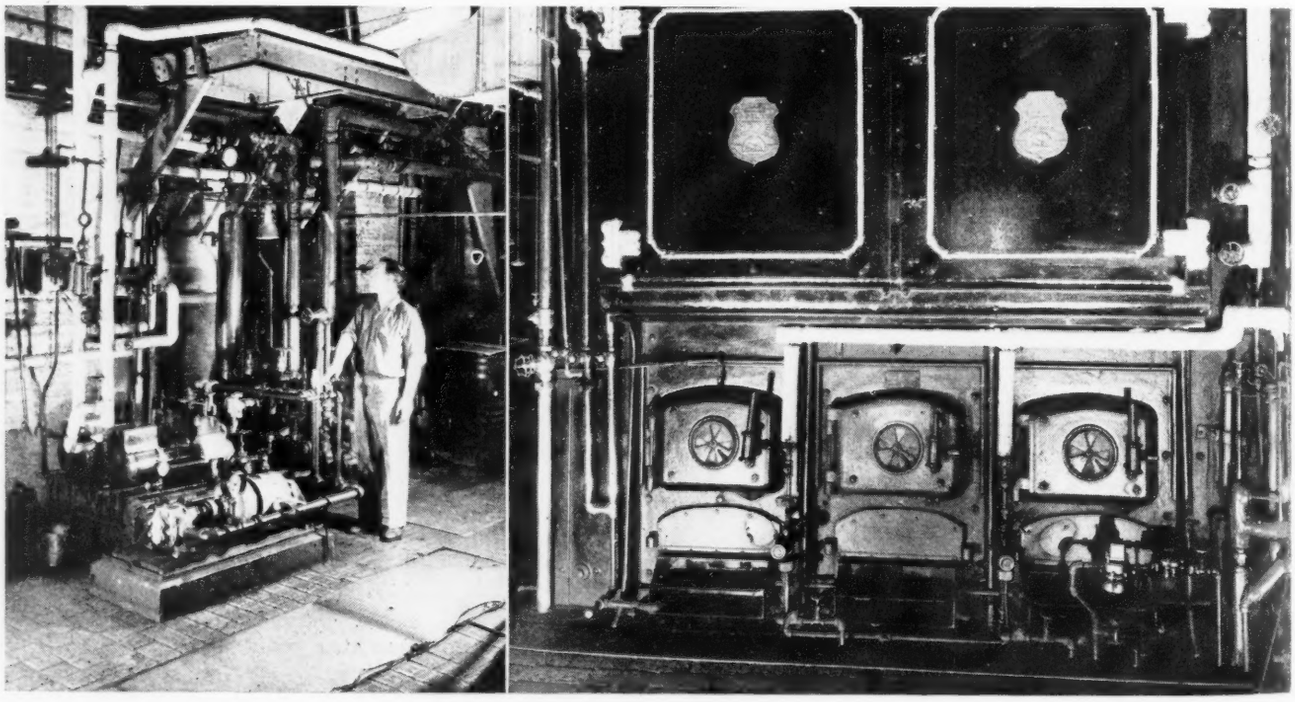
Removing some old refrigerating equipment from the engine room would provide ample space for the turbine, its condenser and the condensate and circulating-water pumps. Building steel had ample strength to support a cooling tower on the roof and the circulating-water piping to and from the tower could be installed at low cost in a large court outside the building. Thus, the turbine could be installed without in any way interfering with normal building operation.

Turbine Selected

As a result of these findings a 475-hp, 4480-rpm low-pressure turbine was installed to operate on a pressure range of 2 lb gage to 26-in. vacuum. This turbine exhausts to a 1270-sq-ft surface condenser and is geared to a 300-kw 1200-rpm, 250- to 125-volt 3-wire generator.

The condenser circulating-water cooling tower, which is rated 1200 gpm from 115 to 90 F, with a wet-bulb temperature of 75 F, is located on the roof of the building 175 ft above the condenser, and is connected to it by 10-in. pipe. To prevent water in winter freezing in this pipe and the cooling-tower pan, when the turbine unit is not operated on Sundays and holidays, provisions are made for admitting live steam on the suction side of the circulating-water pump for a few minutes while the pump is circulating the water. This method worked satisfactorily last winter.

The turbine takes steam from the low-



On the left the fuel-oil heaters and pumps and on the right one of the two 3000-sq-ft oil-fired watertube boilers that operates at 130 lb saturated. Boiler plant includes another 3000-sq-ft and a 2250-sq-ft oil-fired unit and two coal-fired units

pressure exhaust header. All five engines and boiler-feed and fuel-oil reciprocating pumps are connected to discharge into this line. All steam taken from this line goes through a chain-baffled water and grease extractor. Steam for the turbine is taken through a second water and grease extractor so that this steam is cleaned twice before reaching the turbine. Any deficiency in low-pressure steam for the turbine and for heating is supplied through a reducing valve between the high-pressure and exhaust headers.

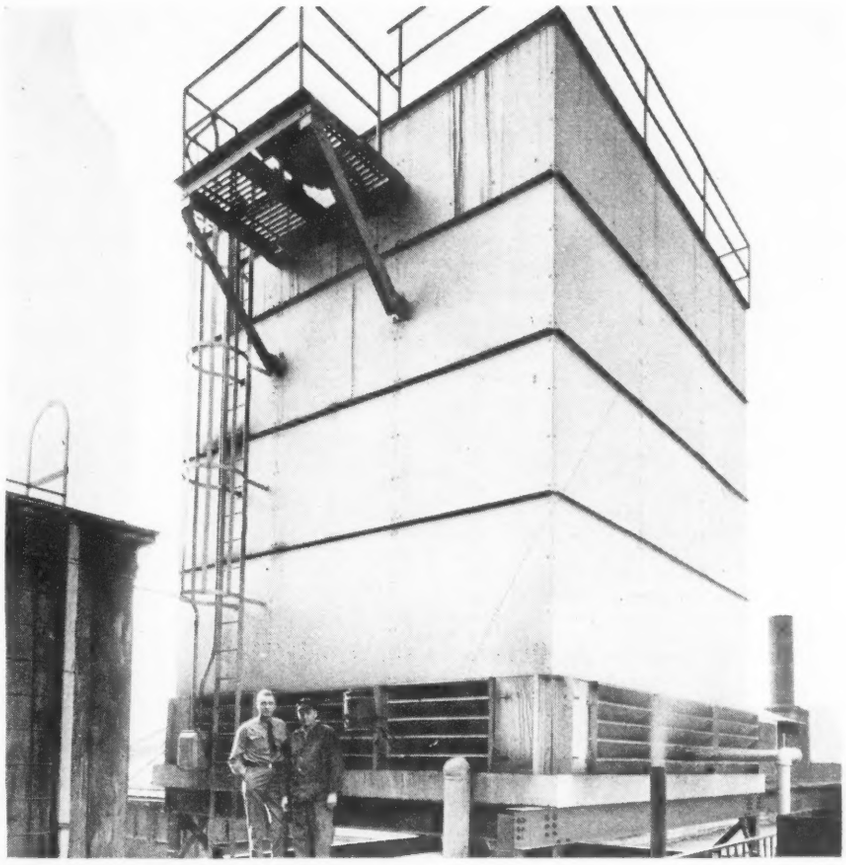
Turbine Operation

The turbine has now been in service for 12 months and has substantially reduced operation costs. Before the turbine was installed a large part of the exhaust went to atmosphere, which meant that a high percentage of the feedwater had to be makeup. Since the turbine went into service all exhaust is returned as condensate and the feedwater treating problem has been reduced accordingly.

Each boiler is equipped with a steam-flow air-flow meter with a temperature pen connected to the uptake from the boiler. Fuel oil is also metered. With these records a fairly close check can be kept on boiler performance and the steam-flow air-flow pens give the operator an accurate guide to maintain correct fuel-air ratio in the furnace. Uptake gas temperatures also adds to the essential operating information.

Feedwater Problem

Feedwater is a problem in every boiler plant, particularly where a large part of it is condensate from reciprocating engines. The oil problem has been completely licked by taking all exhaust steam that will be returned as condensate, and all steam for feedwater heating, through two water and grease extractors in series. Not the least trace of oil is ever found in the boilers. Feedwater treatment is in charge of the Hall Laboratories, but daily checks are made on it by the chief engineer and treatment adjusted accordingly. On the night shift the watch engineers blow down the boilers a given amount. This treatment keeps the boilers in first-class condition.



Cooling tower for turbine-condenser circulating water located on building roof is rated 1200 gpm from 115 to 90 F, with a wet-bulb temperature of 75 F

At least twice a year the engines are indicated and if there is any doubt at any other time about an engine's performance it is indicated at that time. The fact that some of these engines, even though 31 years old, are in as good condition and operating as efficiently as when first installed, speaks well for the way the plant is operated.

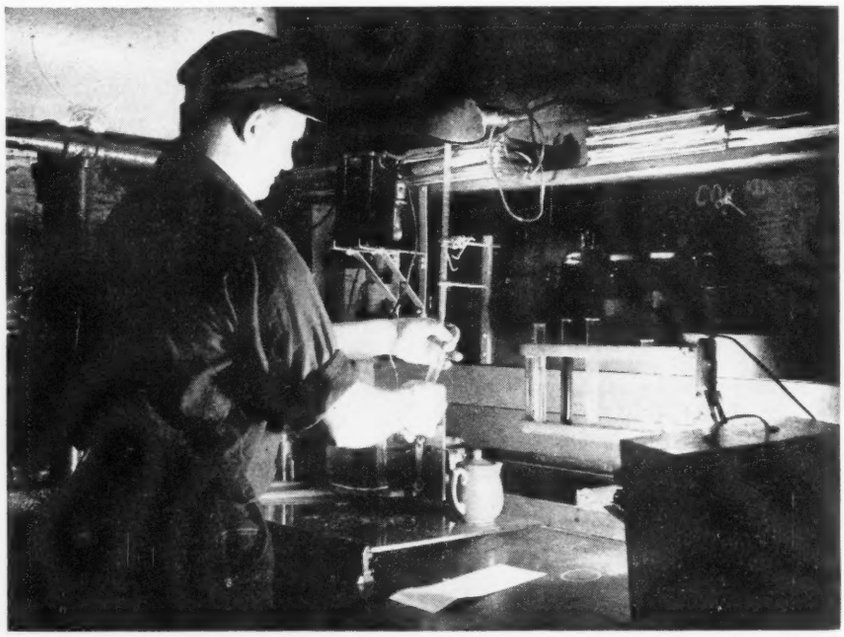
Operation of this plant for the last 16 years has been directly in charge of Charles F Dobbie, an ex-marine engineer. Chief Engineer Dobbie's philosophy of power-plant operation may be summed up by saying, "Eternal vigilance keeps down operating costs, produces high efficiency, and insures 100% reliable service from the equipment." The Chief says: First, keep the equipment scrupulously clean. By doing this you will find the little defects and can correct them before they cause unexpected trouble. If you do this, your serious troubles will be few. Don't take chances. Thoroughly understand your plant and what it can do under all conceivable conditions and be sure that your assistants also know this. Then if an emergency does arise it is only a matter of routine operation to meet the situation.

NEW EQUIPMENT IN 415—5TH AVE POWER PLANT

Steam turbine.....Terry Steam Turbine Co
475 hp, 4480 rpm, 2 lb g to 26 in. vacuum
Reduction gear 4480 to 1200 rpm.....Terry Steam Turbine Co
Generator, dc.....Crocker Wheeler Electric Mfg Co
300 kw, 1200 rpm, 125 and 250 volts, 3 wire
Surface condenser, 1270 sq ft surface, 5/8 in tubes..The Lummus Co
Steam-jet air pump, two-element single-stage.....The Lummus Co
Condensate pump, centrifugal, 30 gpm.....Warren Steam Pump Co
Condensate pump motor.....General Electric Co
Circulating-water pump, 1100 gpm..Worthington Pump & Mach Corp
Circulating-water-pump motor, 40 hp.Crocker Wheeler Electric Mfg Co
Turbine-oil filters.....S F Bowser & Co
Reducing valves.....Reading-Pratt & Cady Div
Turbine tachometer.....James G Biddle & Co
Steam separator and grease extractor combined
Utility Steam Specialties Co
Capacity 13,000 lb of steam per hr
Cooling tower.....Phillips Cooling Tower Co
1100 gpm from 115 to 90 F, 75 F wet-bulb temperature
Cooling tower, steel supports.....Weatherby Steel Co
Turbine and pump foundations.....H D Hynds Co
Electrical work.....Albin Gustafson Co

Stop **CORROSION** *Attack*

Carbon dioxide in water may cause more trouble than oxygen, particularly if it's liberated at a trap discharge or similar point. Bill Maddock tells in plain language how corrosion acts and gives a handy list of things to do about it



IN NEARLY all hot-water process work as well as in steam plants, the boilers, economizers, heaters, feed and water lines are besieged to some extent by erosion, corrosion, or both.

Erosion is a mechanical action; molecules of the material are actually torn away by abrasion or scuffing. Typical examples of erosion include wearing of valve seats and elbows in air lines. Most erosion difficulties can be reduced by making the fluid involved move at a slower rate. This article deals with the harder problem of corrosion.

The simplest kind of corrosion represents a straight reaction between iron and oxygen. Chemically, this is:

$$2\ Fe + O_2 = 2FeO$$

Reduced to understandable language, this means that 3.45 lb of iron will unite with one lb of oxygen to give 4.45 lb of iron oxide. This reaction will continue until the supply of iron or oxygen is exhausted.

Strange as it may seem, the same result may be obtained in the complete absence of free oxygen, if water with CO_2 dissolved in it is present. In water, CO_2 makes carbonic acid, which is H_2CO_3. The first thing that happens when carbonic acid comes in contact with iron is replacement, by iron, of the hydrogen in the carbonic acid. The chemist writes it this way:

$$H_2CO_3 + Fe = H_2 + FeCO_3$$

Under heat, the *ferrous* (iron) carbonate breaks down into iron oxide and CO_2, which is released. In a boiler the CO_2 would pass off with the steam and reappear in the condensate, causing the cycle to repeat. Thus, in theory at least, it would be possible for one molecule of CO_2 to cause an entire piping system to rust away.

Oxygen Attack

Water with only one part per million of oxygen could pick up 0.08 lb of iron each day for each 1000 lb per hr water flow. To offset this attack would require the addition of the same amount (0.08 lb) of finely divided iron daily for each 1000 lb per hr water flow.

Sodium sulphite may also be used to stop oxygen attack. Addition of quantities equal to eight times the amount of oxygen is necessary. At 1000 lb per hr flow, 24,000 lb of water would pass through the system in a day. If one part per million of oxygen was present, there would be one-millionth of 24,000 lb, or 0.024 lb of oxygen to be removed each day. On the basis of eight times as much sodium sulphite, 0.192 lb would have to be added each day, for each 1000 lb per hr flow.

These figures make it easy to see why chemical reduction of oxygen is expensive and why it adds to the total concentration of dissolved solids. Mechanical deaeration is the efficient, economical and practical way to reduce oxygen down to about 0.05 ppm, with chemical treatment (sodium sulphite usually) for the last traces.

The ability of small amounts of CO_2 to cause extensive corrosion, as described before, indicates the importance of reducing it to the lowest possible value. Mechanical deaeration effectively eliminates CO_2. Adding caustic to the water keeps the solution basic and materially retards the displacement of hydrogen by iron which was shown to be the first step in the corrosive action of carbonic acid. Of the common caustics, sodium hydroxide would be the most logical to use if it were not hazardous to handle. Soda ash (sodium carbonate, Na_2CO_3) is usually preferred but its use tends to defeat its own purpose because it breaks down under heat to give the desirable sodium hydroxide (NaOH) and the objectionable CO_2.

Highly alkaline solutions are supposed to have been responsible for *caustic embrittlement*. This type of corrosion or crystalline fracture was more or less alleviated by maintaining a sulphate compound in excess of the caustic in accordance with the well-known ASME ratio. We found, in a 400-lb 750-F plant, that when sodium chloride was held at one-half the caustic and one-sixth the sulphate, no embrittlement was noted. When the ratio fell off there were definite signs of crystalline fractures. Recent laboratory tests show that silica is a major factor in embrittlement and that sodium chloride does inhibit the action if held to the proper ratios.

Highly caustic waters can be re-

duced by sulphuric acid, but the process may be hazardous. The addition of disodium phosphate will reduce the total methyl-orange alkalinity but will not necessarily cut the pH value. The reaction is:

$$Na_2CO_3 + 2Na_2PO_4(H) = 2Na_3PO_4 + H_2O + CO_2$$

In other words, the phosphate breaks up the carbonate and liberates CO_2, which then has to be removed by deaeration. The benefits of disodium phosphate are twofold inasmuch as the reaction produces trisodium phosphate that is available to combine with any calcium or magnesium to prevent scale formation.

Peculiar conditions arise where it is not possible to treat chemically. For instance, condensed bleed steam may be low in pH, high in dissolved oxygen and contain CO_2. We have found that, without a doubt, the heater drip return lines suffer more from corrosion than any others in the plant. A series of tests run on an 800-lb 4-stage bleeding turbine showed a normal pH value for the drips of 6.2. Pressures on the bleed lines ran from 300 lb to 17 in. Hg. The piping on all four return lines failed after about six months. Later, boiler water was added to the steam side of the highest stage heater and cascaded down with the drips to give pH values of 10.2, 9.0, 8.3, and 7.8, after each succeeding dilution by the condensed bleed steam. This arrangement was used about one year, with no evidence of any corrosion. However, the practice was discontinued, lest the heater tubes become dezincified from the high pH on the steam side. Because the most frequent failure came at the first connection or ell after the trap, it was concluded that the sudden flashing at the trap discharge liberated oxygen and CO_2. Since internal chemical treatment could not be recommended, the piping was changed to red brass.

In general, our experience indicates that:

1. In cold water, a pH of 6.3 is not serious if oxygen is absent,
2. Oxygen is not detrimental in cold water if there is sufficient pressure,
3. Combined oxygen and CO_2 may be serious at any temperature,
4. Regardless of temperature or pressure, small amounts of CO_2 and oxygen are serious if there is any change of conditions that would tend to liberate either or both gases. This applies to all evaporator surfaces, trap discharges, pressure-reducing stations, metering points, etc. and
5. Control of pH and CO_2 are just as important as oxygen control.

Table I—SUGGESTED TREATMENTS

Trouble	*Remedies*	*Remarks*
Acid feedwater, caused by CO_2 or pollution	(1) Deaeration	Effective; requires equipment
	(2) Sodium carbonate (4–10 ppm)	Adds to concentrations
	(3) Sodium hydroxide (2–6 ppm)	Adds to concentrations; corrosive to iron; hazardous
	(4) Sodium phosphate (2–8 ppm)	Adds to concentrations; requires special lines; corrodes iron if concentrated; not too effective
Oxygen, entrained in water or from condenser leak	(1) Deaeration	Effective; requires equipment
	(2) Sodium sulphite, ferrous hydroxide, finely divided iron	Adds to concentrations; has to be continuous; costly for the results obtained
Embrittlement, caused by high alkalinity	(1) Sodium sulphate	Adds to concentrations; not always effective
	(2) Sulphuric acid	Hard to control
	(3) Disodium phosphate	Liberates CO_2
	(4) Continuous blowdown	Effective; requires equipment
Scale, from silica and calcium and magnesium salts	(1) Evaporation (makeup)	Effective; requires equipment
	(2) Trisodium phosphate	Adds to concentrations; not most effective
	(3) Disodium phosphate	Adds to concentrations, but less than trisodium phosphate
	(4) Hexametaphosphate	Adds to concentrations
	(5) Zeolite or lime-soda	Effective; require equipment

Table II—REASONABLE CONCENTRATION LIMITS

(*All figures except pH values are in ppm*)

	Raw feedwater	*Condensate*	*Boiler water*	*Circulating water*
Total hardness	0–170	0–10	Nil	0–100
Total alkalinity	10–250	4–40	100–400	50–1000
Sodium chloride	(Not more than ½ the alkalinity)			0–400
Sodium sulphate	(From 2 to 3 times the alkalinity)			0–2000
Sodium phosphate	0–10	1.0	30–60	0–6
Sodium sulphite	0–10 times O_2	0–1	30–60	None
pH	7.0–8.5	7.0–8.5	10.5–11.5	9.5[1]
Total concentration	500	50	500–3000[2]	3000

[1] Condensers equipped with brass should run lower, but not below 7.0.
[2] High-pressure, high-heat-rate boilers should be limited to about 1200.

✦ ✦ ✦

Explosions in Furnace Prove Mystery Until Manager Uses His Nose

A SERIES OF EXPLOSIONS that occurred one morning in the furnaces of a coal-fired horizontal tubular boiler at a New England plant proved puzzling until an alert manager with a good sense of smell discovered the cause.

It was the practice at the plant to bank the fire at the close of each day's work. On the morning of the explosions the fireman loosened the banked fire preparatory to getting up steam. Soon afterward the series of detonations occurred within the setting. The first was severe enough to crack the masonry; subsequent ones were of less intensity.

Of course there was considerable anxiety among the plant personnel. The fuel was examined closely, as were the dampers. However, when the manager was called to the powerhouse, he at once detected the odor of illuminating gas.

This was puzzling since the plant had no gas connection in the boiler room. The source of the odor was traced to a crack in the concrete floor directly in front of the ash-pit doors. It was decided that gas from this source was the cause of the explosions; that when the banked fire was broken and the doors opened, the draft drew the gas rapidly into the setting.

When gas company men had dug down to a gas main near the building, they found a small hole the size of a dime in the main at a point approximately 22 ft from the ashpit doors. The sandy texture of the ground surrounding the main permitted the gas to seep to the crack in the boiler room floor.—*The Locomotive*

READERS' PROBLEMS

Questions from Our Readers

Rating Power-Transmission Equipment

Question 1

CLUTCHES, SHAFTING, COUPLINGS *and other mechanical power-transmission equipment are rated in horsepower at 100 rpm. I understand that if a clutch is good for 5 hp at 100 rpm, then it is supposed to transmit (300 ÷ 100) × 5 = 15 hp at 300 rpm. This brings up the question of the effect on a clutch of accelerating the 15-hp load to 300 rpm instead of a 5-hp load to 100 rpm. To do the 15-hp job would seem to put a more severe strain on the clutch. Maybe some* POWER *readers can tell me what allowances to make for the higher-speed conditions and how to provide for them. No doubt a discussion of how clutches and couplings are rated would be illuminating to a lot of us.*—MEW

Boiler-Feed Pump

Question 2

IN OUR PLANT WE SHOULD HAVE *a reserve boiler-feed pump. We have a spare pump which is suitable for this purpose in every way except that we have no driving unit. As the pump is complete with necessary bearings we would like to use a belt drive from our main engine shaft. Using this drive requires only a short run of piping and will permit us to utilize available power from the engine. By driving the pump in this manner we will have no control of the speed, and as the boiler-water level is controlled automatically, what governing devices can or must we use to prevent damage to the pump? Will this setup make a dependable feedwater supply so that we can keep one of our governor-controlled pumps as a standby unit?*—RKT

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Cable Damage

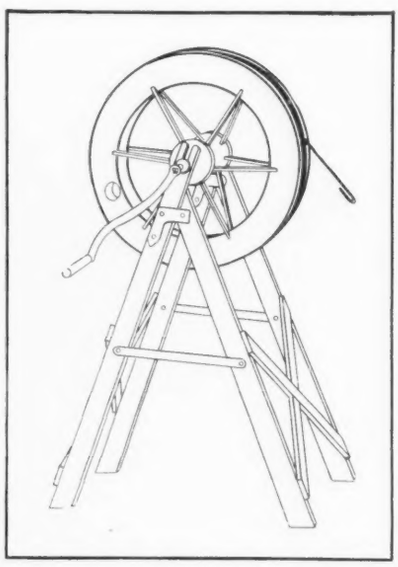
Answers to Dec Question 1

The Question

I WILL SOON BE RESPONSIBLE *for pulling control cable into long runs of conduit. This cable is the usual 6-, 8-, and 12-conductor with rubber insulation and fabric-braid covering. As the runs are long and have numerous bends, how will I know what pulling force to apply, and is there any limiting device which I can use to prevent stretching the cable? Is it possible that under this condition cable may be stretched to such an extent that the insulation will fail between conductors?*—RLZ

Wire Strength Determines Allowable Pulling Force

IN SOME LOCALITIES the electrical code limits the length of a conduit run between pull boxes, the object being to prevent stretching the cable and breaking down the insulation. The general practice is to have a pull box every 100 to 400 ft, depending on the number of turns in the run.



Copper wire acts in a very different manner than iron wire. Copper does not obey Hooke's Law and its stretch varies with the condition of the copper and the amount of work that has been done on it. For these reasons it is difficult to determine the stress at which the copper will stretch and cause trouble. The breaking point of copper wire is shown in a number of handbooks. These figures show that comparatively little strain can be put on wire without danger of damage.

Figures given for annealed wire will show that:

No. 12 wire breaks at 198 lb
No. 8 wire breaks at 481 lb
No. 6 wire breaks at 763 lb.

Therefore, great care must be used, particularly on the smaller sizes.

The accompanying sketch shows a convenient method of pulling wire through conduit, at the same time providing a means of limiting the force applied to the wire. A friction clutch having spring adjustment is installed between wire reel and the handle. By using an ordinary spring scale, the clutch may be adjusted to slip at approximately a given load, and therefore handle various-sized wire. The arrangement also keeps the pull wire in good shape for the next run.

Lakewood, Ohio J P SIMONS

Install Pull Boxes Instead of Bends

RLZ FAILS TO TELL the size of the conductors or the size of the conduit, which are the things that govern the pulling force required. From the question I take it that the conductors are all in one braid and are small in size. In this case not enough force can be applied by hand to cause any damage to the insulation. If the runs are exceptionally long and have over three or four bends, it may be necessary to install pull boxes, or fittings with removable covers can be used instead of pipe bends. These work fine, are inexpensive, and can be obtained in either right- or left-hand bends.

I don't know of any practical limiting device that can be used. If the runs are already in, enough force must be applied to pull the wires through. By using a rope, fish line, or other wire for pulling, it will break before the conductors are damaged. I have never seen a multiple conductor stretched by pulling, even with the use of a winch and $\frac{3}{8}$-in. wire rope.

Talc fed into the conduit with the conductors helps them slide through. Local conditions are the governing fac-

tors in all cases of this kind. My advice would be not to try to pull over two or three bends, if the conduit does not offer much clearance for the wires and the runs are exceptionally long.

Wilmette, Ill. E O SCHMOKER

Use Proper Tackle and Practical Judgment

THE SAFE INSTALLATION of RLZ's cables depends on the layout of the job, proper placing of the pull boxes, elimination of right-angle bends as far as possible, and intelligent care in pulling and feeding the cables.

The runs, having numerous bends in this case, may demand extra pull boxes throughout the line. Do not attempt to pull these cables around more than two right-angle bends at once. The reason for this is obvious. On straight runs, do not attempt to pull more than 100 to 120 ft at a time.

Use plenty of powdered talc or soapstone blown into the conduits and apply liberally as the cables are being fed in. Do not use grease on this type of cable as this is only permissible for lead-covered cable, and if applied here will eventually rot the insulation.

Use a light set of rope blocks and practical judgment, and no trouble should be experienced.

If these cables are to be pulled into separate conduits, condulets and ells will take the place of pull boxes.

Kearny, N. J. GEORGE MCNALLY

V-Belt Tension

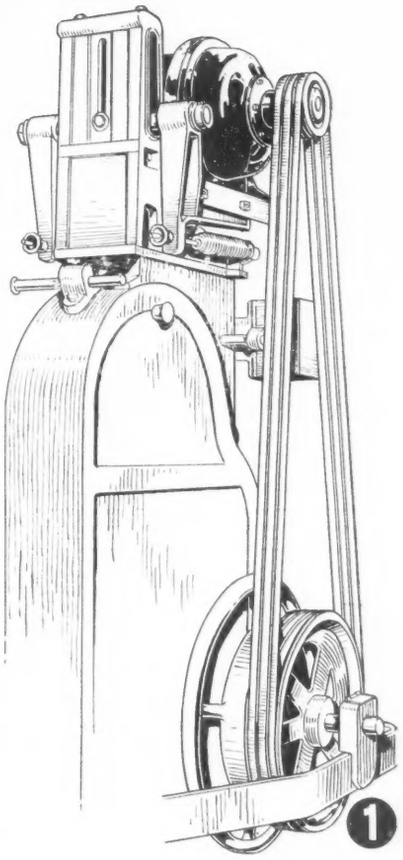
Answers to Dec Question 2

The Question

WE HAVE HAD A LOT OF DISCUSSION *in our plant about the effects of unequal stretch of multiple V-belts. Some of my associates claim that, if each belt takes its share of the load, unequal stretch makes no difference, while others are equally certain that it does. The latter is apparently the generally accepted opinion among industrial engineers, and V-belt manufacturers match their belts for length. However, I have not found any good reason why and how a small difference in the length of several V-belts operating in parallel affects their operation. Maybe some* POWER *readers can enlighten me and my associates on this apparently debatable point.*—CR

Small Amount of Stretch Makes no Difference

SIMPLY BECAUSE SEVERAL V-belts operating in parallel have different tensions does not indicate that some of the belts transmit more power than the others. Also, because the belts with the most tension wear out faster than the others is no proof that they are taking more than their share of the load. Power transmitted by the belts is only one factor that determines belt life. Excessive tension is frequently more destructive than the actual hp load transmitted.



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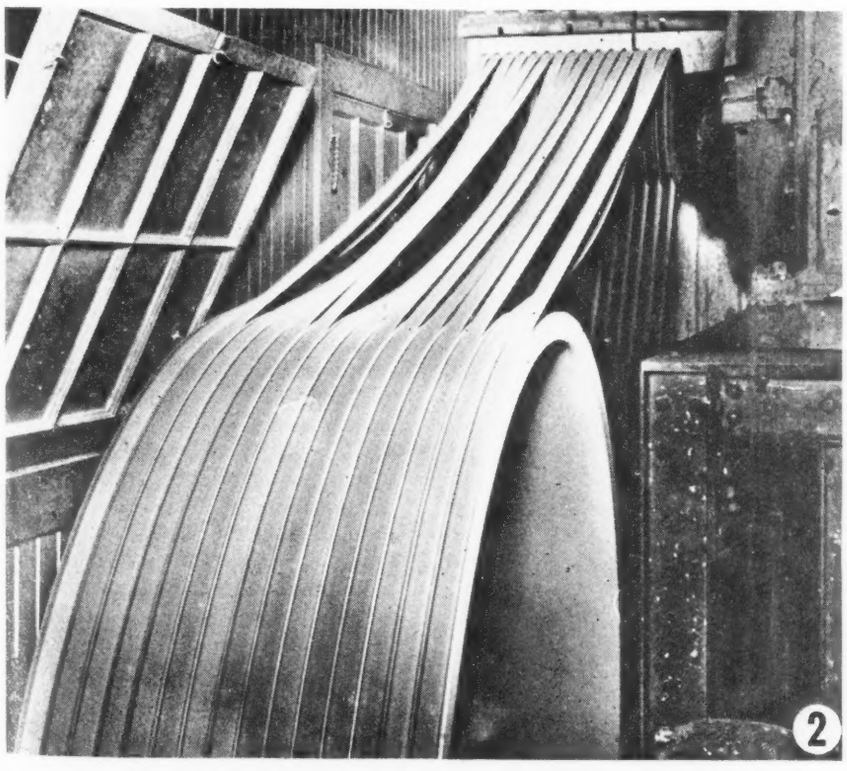
The opinion that a slack V-belt shirks its share of the load in a multiple-belt drive seems to have developed from the erroneous idea that each belt is transmitting all the power it can without slipping. Let us consider how a properly designed V-belt drive is selected. First we start with the load, air compressor, pump, fan or what have you. We must know this so that a proper service factor may be used in the selection of the belts. The other thing that we want to know is the motor type, horsepower, speed and method of starting. Note here that nowhere is there anything said about the actual horsepower required to drive the load. We are interested only in getting a drive suitable for connecting a certain size and type of motor to a load possessing certain characteristics.

Assume the load to be a positive-type blower that requires 57 hp to drive it. This unit will require a 75-hp motor, which we will assume is of the wound-rotor type. When selecting the V-belt drive, we want to get sufficient capacity to connect a 75-hp motor to an assumed 75-hp load, which in fact is only 57 hp, but we do not know that.

We look in the V-belt manufacturer's



2

tables and find that the service factor for such a load and motor is 2. This means that the motor horsepower is to be multiplied by 2 to get 75x2=150 hp.

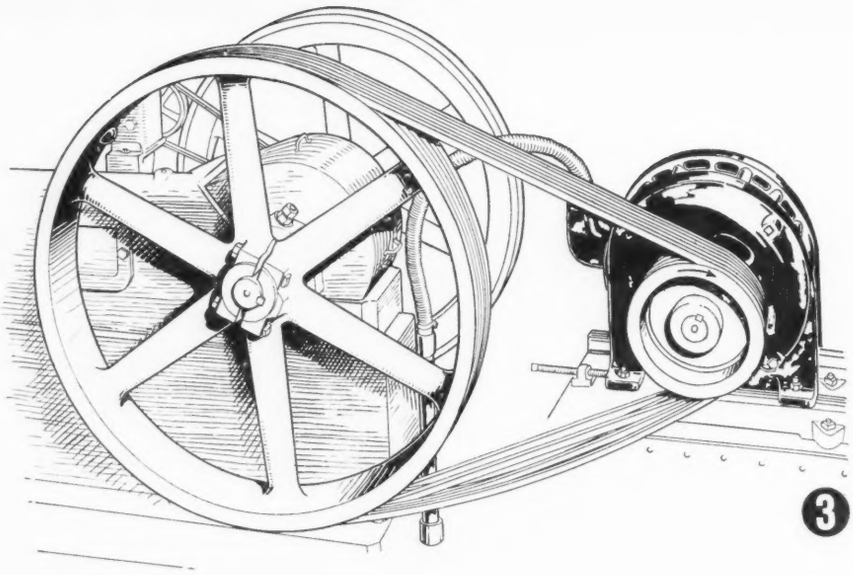
We are now headed for a 150-hp belt driven by a 75-hp motor. But that is not all. Assume the belts are to make only 105-deg contact on the small sheave. To allow for this we use an arc-of-contact factor of 1.3 and the normal belt capacity increases to 195 hp to drive a 57-hp load. This is an extreme case, but it does show how much difference under certain conditions there can be between actual load and the normal belt capacity selected to do the job. Even with a service factor of 1.2, as used for certain loads, when properly selected the belts are only partly loaded. Therefore, simply because one or two of the belts stretch a little more than the others is no reason for believing that they are slipping or shirking their load.

The difference in stretch in a group of belts is frequently due to giving them too much initial tension when putting them on the sheave. This is done by abusing the belts when putting them on the sheave, by not moving the motor close enough to the load and forcing them from one groove to another.

Belts are not homogenous structures no matter how or from what they are made. They will all act differently under the same conditions. This is not a criticism of belts, but is something that is true of every built-up structure. If belts are put under excessive tension they will stretch differently and when they reach a practically constant condition some will have stretched a little more than the others. It requires only a very small fraction of an inch in stretch to make a considerable difference of sag in the belts.

The effect of the difference in stretch will depend upon the position of the drive, whether the tight side of the belt is on the top or bottom, or the speed of the drive. On a vertical drive with the motor on a fixed base below the driven pulley, any slackness tends to permit the belt to fall away from the motor sheave and shirk the load. If the motor is on a tension base above the driven pulley, Fig. 1, page 103, then the effect of the slight difference in tension is at least partly compensated for.

On a horizontal drive, or one that is nearly so, with the tight side on the bottom, Fig. 2, the effect of difference in stretch of the belts will be minimized. Any slight difference in belt length is taken up by sag on the top, which increases the arc of contact with



the sheave grooves and increases their power-transmitting capacity. If the slack side is on the bottom, Fig. 3, then the slack belts tend to fall away from the grooves, decrease the arc of contact and reduce the power-transmitting capacity. However, if the belts have been properly selected, they probably have sufficient capacity, even though slack, to transmit their share of the load. I cannot see where a slight difference in stretch in the belts makes much difference if the belts are properly selected and operated. I will be interested in reading the opinion of others.

Philadelphia, Pa. R O Spencer

Matched Belts Give More Value for Money

In the question on V-belt tension by CR, the use of matched V-belts will depend somewhat on the type of service, speed, and strain put on the belts. In most cases matched V-belts are best; however, where the pulleys are large, and load fairly light, the need for all belts to be matched will not be great, but all the belts will need to be as near the same length as it is possible to get them. The reason that unmatched belts could be used in this case is that there will be enough bearing surface on the pulleys so that any small difference in the belt lengths will not make any difference in their life.

In cases where the load is light, belt speed not excessive and where the belt pulleys are not too close together and not too small, then unmatched belts might give good service. But in cases where one pulley is small, with average speed and heavy or pulsating load, such as for driving compressors, then by all means matched V-belts should be used.

It is my contention that where more than one V-belt is used, all belts should be matched. These belts will not cost much more than unmatched belts and will give better and longer service. Considering the cost, better service and longer life of matched belts will give the user more value for money invested, because when the belts are of equal length the wear is the same on all belts, but when they are unmatched, the strain and wear is uneven. The longer belts will flop more or less and in doing so will cause wear where they strike the pulley, and this will flex the cords in the belting to the point where they will slip and eventually break. Whenever this happens it causes more strain on other belts.

Bismarck, N. D. Leslie Bradley

Unequal Stretch Not as Important

It is an established fact that when two or more V-belts operate under the same conditions except as to load and tension, the belts which have the more tension and the more load will wear out earlier than those belts with the less tension and the less load. Observation of many multi-V-belt drives on which the belts were matched with the sheaves reasonably in alignment, shows that all the belts get about equal wear and last about the same length of time. Therefore while there is probably some difference in the loads which each belt carries, that difference is negligible. Of course it seldom happens that all of the belts on a multi-V drive fail at the same instant. This would not happen even if the load were exactly evenly distributed among the belts because no

two belts ever have exactly the same life expectancy.

There is no doubt that among poorly matched V-belts operating in multiple, the tighter belts carry considerably more load than the loose ones. This inequality of load depends on how unequal is the stretch or tension. Where the drive is horizontal and the sheaves are above the minimum diameters recommended, the effect of unequal belt stretch and tension is not as great as it would be on a drive that is vertical or on a drive using minimum or less than minimum recommended sheave diameters. On long horizontal drives where the slack side is on top, the effects of unequal stretch are partially corrected by the improved arc of contact with the sheaves. However, many V-belt drives are too short-centered to gain this advantage.

The appearance of a multi-V-belt drive in which one belt sags more than another is deceiving as an indication of the distribution of load among the belts. A difference in stretch between two belts of only $\frac{1}{16}$ of an inch may cause one belt to sag $\frac{1}{2}$ inch lower than the other even though it will be pulling practically the same load. Calculated as a percentage of center distance, the difference in the sag of two belts will be roughly ten times the difference in stretch.

It can be safely assumed that in a set of multiple V-belts, matched according to industrial practice and run on sheaves reasonably well aligned, each belt carries an equal share of the load notwithstanding differences in stretch and sag.

Mountain View, N. J. JAMES ADAMS

Alignment of Pulleys, Tension Adjustment

V-BELTS ARE MADE TO RUN in either direction with slack on the top or bottom. They are reversible as readily as an induction motor. The line joining the centers may be vertical, inclined at any angle or horizontal. Allowances are made for slight adjustments, approximately 10% of the total center distance between centers, to facilitate installing new belts or removing old belts that have been stretched.

Motors are usually assembled on adjustable bases to allow for belt changes and adjustments. The sheaves should be carefully aligned for proper operation and longer belt and sheave life. After the drive has been started and is running at full load, adjust takeup until a slight bow is seen in the slack side. Experience will give the correct amount of bow. If the drive is either vertical, or an extremely short center, quarter-turn or a drive carrying a pulsating load, it must be operated a little tighter than others.

Sag increases after the first few days of operation because of deeper seating in the sheave grooves. Slack should be taken up by adjusting shaft centers. At this time any small differences in length when first installed will soon disappear.

Never use belt dressing on this type of belt. If the belts slip, clean them with a cloth dampened in gasoline, then tighten the drive. There should be a constant free circulation of air around sheaves and belts. If guards are used, they should be of the screen type. Belts will operate satisfactorily with an ambient temperature of 140 F. For a greater temperature, manufacturers supply correct belts for proper operation. Oils and greases have a bad effect on all belt drives. Dust, dry chlorine, sulphur dioxide, and other chemical gases have little effect on their operation. Fine spray or rain will reduce the coefficient of friction of belts on the sheaves, requiring a larger service factor. Steam and water may be used to clean these belts without any ill effects. Belt storage should be in a cool, dark place away from radiators or direct sunlight.

Fairview, N. J. M N GOZDENOVICH

Slack Belts Pull Fair Share of Load

WHERE A NUMBER OF BELTS are transmitting power there is a difference in the load carried by the different belts; this is also true in drives equipped with new belts; any difference is frequently apparent in the tension between the different belts, but the seriousness of such condition many times has been exaggerated. At a low belt speed of 1400 to 1600 ft per min the belts pull by a wedging action and the slacker belts pull a fair share of the load regardless of the difference in tension. However, with the higher speed drives, centrifugal force tends to lift the belt out of the grooves and the wedging action is less effective with some difference in slip. Therefore, the higher the belt speed the less the wedging effect and the greater the difference in tension between the belts.

Schenectady, N. Y. CARL BACHMANN

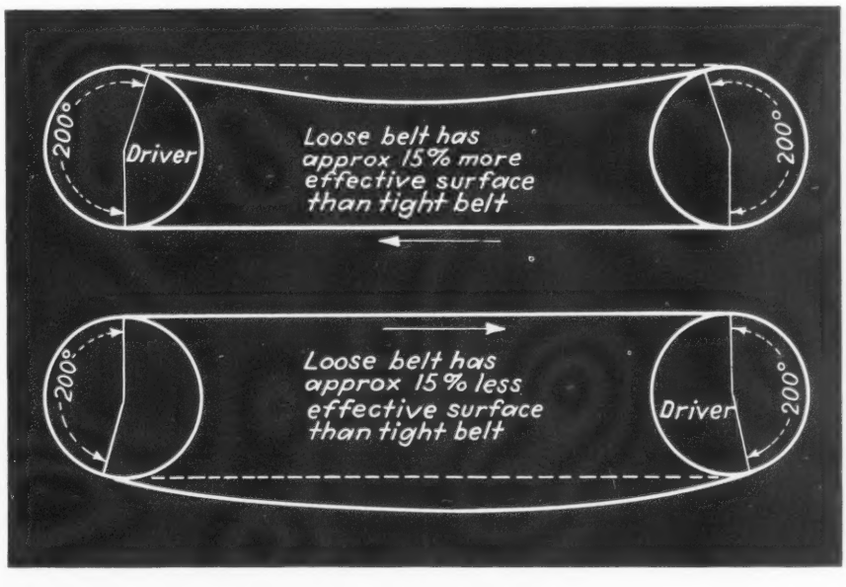
Arc of Contact Controls Power Transmitted

CR'S QUESTION of V-belt efficiency is no more debatable than if applied to ordinary flat belts. Any belt takes its share of the load according to its arc of contact on the pulleys in question.

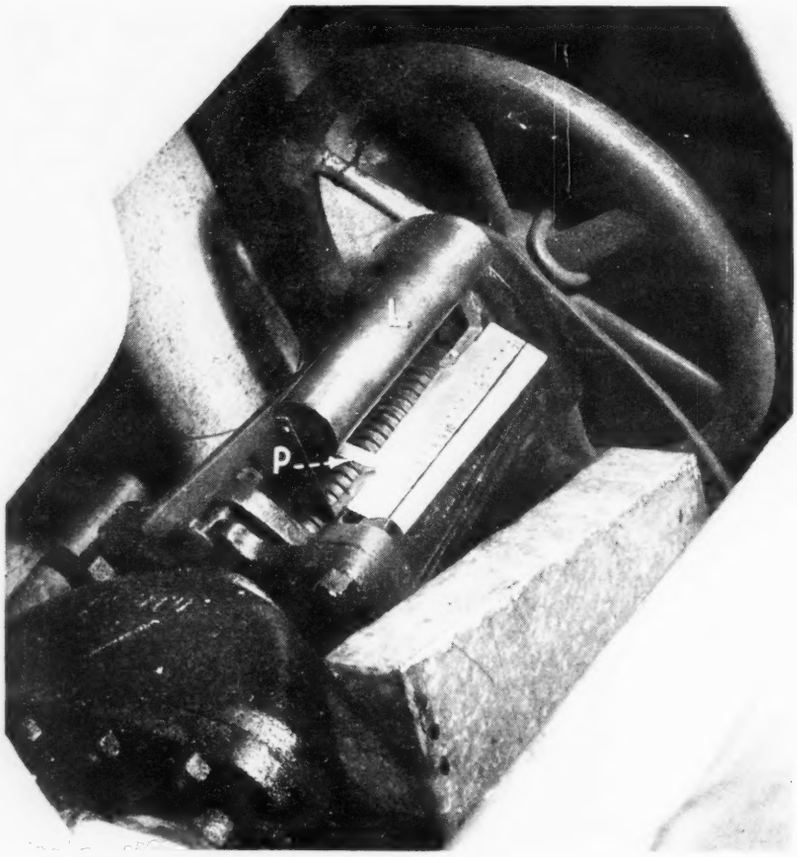
An ordinary flat belt, having the driving or tension side on the bottom of the pulleys, will transmit power with greater efficiency than a tight belt, because of the greater circumferential surface which it contacts on drive and driven pulleys. However, should the driving side be on the top of the pulleys, then the opposite results are true.

This fact, of course, applies to a group of V-belts in similar manner. There is a very small loss due to the belt stretch under tension, but this is small enough to be negligible, as shown by the accompanying sketch.

Kearny, N. J. GEO MCNALLY



PRACTICAL AIDS TO OPERATION



Indicator Shows Overhead Valve Position

How far is the valve open? A handy device which answers this question at a glance can easily be adapted to overhead valves. As shown in the photograph, this device consists essentially of a nut and pointer, *P*, which rides on the threaded valve stem. A scale mounted beside the pointer is graduated in turns from closed to open valve position. A hooded light, *L*, mounted near the scale completes the installation. Turning the hand wheel causes the nut and pointer to move along the scale and indicate the number of turns valve is open.

New York, N. Y. Frank Smart
Chief Engineer, Beth Israel Hospital

Simple Test for Oil in Boiler Water

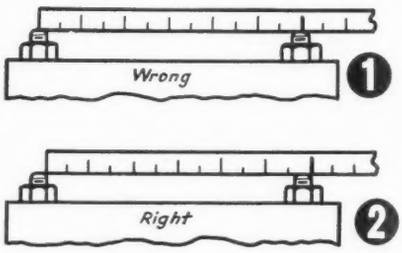
Condensed exhaust from reciprocating engines and pumps is frequently wasted because it is contaminated by oil or grease. Oily condensate, if used for boiler feeding, may cause serious operating troubles, including foaming and priming, overheating of boiler shell or tubes, and corrosion. Oil contamination may cause priming and foaming, as indicated by an analysis of a deposit from the steam space of a boiler, which showed 20% oil, 4% silica, 8.2% iron oxide, 62.8% calcium carbonate and 4.4% magnesium carbonate.

Oil is also carried over with sludge from the boiler water into the turbines and, becoming cooler, congeals and acts as a binder for other substances brought over by priming. One analysis showed that such a deposit consisted of 24.88% oil, 13.8% silica, 6.19% iron alumina, 0.03% calcium sulphate and 55.1% calcium carbonate.

Oil that exists in emulsion or a fine state of division must be coagulated prior to removal by filtration, and for this aluminum sulphate and caustic soda are used. Before it enters the filters, condensate is given a treatment of approximately one grain of aluminum sulphate and 0.5 grain of caustic soda per gallon. The resultant aluminum-hydrate precipitate forms a floc which coagulates the finely divided oil particles, thus holding the oil on the surface of the filter bed.

A helpful preliminary test for the determination of oil in boiler feedwater can be conducted by anyone. Just take an ordinary clean test tube, fill it to about 2 in. with the feedwater to be tested, and shake it in the hand for a few minutes with the thumb over the test-tube opening. If at the end of a short period of shaking there is an accumulation of oil globules on the surface of the water you can be almost positive that there is oil and plenty of it in the feedwater. If at the end of the shaking period there is no evidence of globules, you can be fairly sure that the amount of oil in the feedwater is quite small.

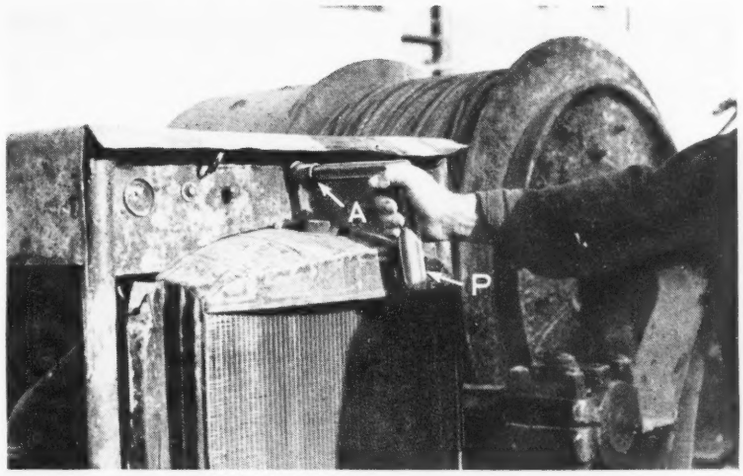
Philadelphia, Pa. S D Distelhorst
Cochrane Corp



How to Measure Distances Between Bolt Centers

Strange as it may seem, many operating engineers when they measure the center distance between two bolts, will try to take measurements from center to center of the bolts, as in Fig. 1, instead of between either their left-hand or right-hand sides, Fig. 2. If an accurate measurement is needed it is difficult to locate the center of the bolts accurately. With the method, Fig. 2, the outside of the bolt diameter is easily seen. Such measurements are made frequently when determining the diameter of bolt circles. The same rule applies when measuring the diameter of the circle on which holes have been bored in flanges.

New York, N. Y. S M Elonka



Extension Simplifies Engine Control

WHEN CONVERTING AN AUTOMOTIVE ENGINE for use as a stationary power unit on a hoist the operator found it inconvenient to go back of the engine each time to shift gears. He therefore, made a guide from a short length of ¾-in. pipe and welded it into the board, as at *A*, at the front of the engine where other controls were mounted. A socket large enough to accommodate the ball atop the gear-shift lever was welded at right angles to the end of a length of ½-in pipe extending horizontally through bushing *A* in the control board.

He then welded a 6-in. length of 1-in. pipe at a slight angle to the engine end of the horizontal control bar. This pistol-grip control handle *P* made it easy to move the gear-shift lever to any position. The clutch was handled by foot from a point closer to the ground where the operator stood.

Pomona, Calif. GILBERT M WILSON

Combination Flat-Belt Tightener and Deflector

OUR EMERY WHEEL WAS ORIGINALLY driven by a flat leather belt, Fig. 2. The belt interfered with the use of the wheel face so the mechanics frequently used the side for grinding. This is dangerous because of the possibility of breaking the wheel while in use. Furthermore, the belt could not be tightened except by resplicing.

To eliminate these difficulties I made a frame to hold two small pulleys, as in Fig. 3. This I supported from a bracket on the wall, Fig. 1, and ran the two strands of the belt over the pulleys as shown by the full lines. The bracket holding the pulley frame is slotted so that the frame and small pulleys can be moved to the position shown by the dotted line to adjust the tension in the belt.

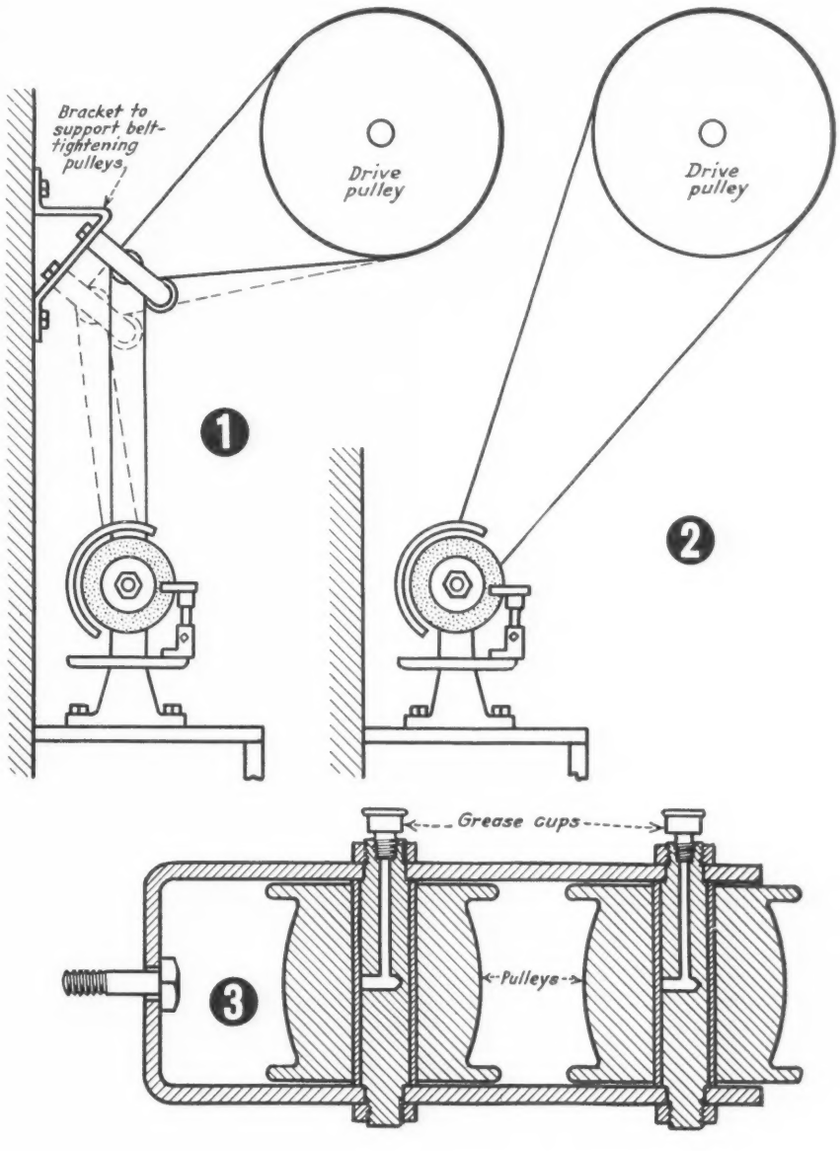
New York, N. Y. S M ELONKA

Small Holes in Valve Insure Dry Steam

PROPER DRAINAGE of soot-blower piping is one of the most important factors influencing the satisfactory operation of this class of equipment. Unless this piping is drained of all moisture before soot-blower valves are opened there is a very real danger of the elements being cracked and the boiler surfaces becoming eroded by water.

Water which might reach the blower elements and cause trouble may come from a number of sources. Among these are liquid accumulations in the branch piping due to leakage steam bypassing the main valve between soot-blowing periods, initial condensation in the lines when steam is turned into the branch piping prior to operating the various blower elements, and steam that condenses in the system while the operator is moving from one blower valve to the next.

This water can be eliminated by

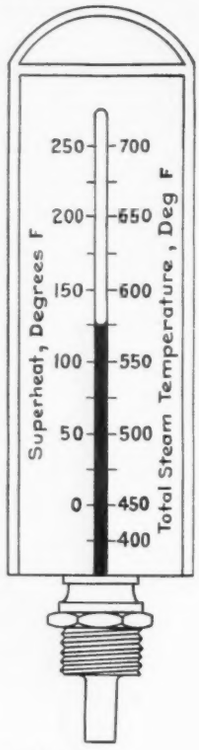


manipulating the drain valve properly. The usual procedure is to leave this valve wide open at all times when soot blowing is not in progress. When the main steam valve is opened the drain valve is throttled but not closed entirely. This procedure takes care of condensation during the blowing operation. There is always danger however, that the drain valve will be inadvertently or carelessly closed. In our plant we have provided against such an eventuality by drilling small holes in the valves to insure drainage under all conditions.

Lynchburg, Va. O M ROBERTS

Superheat Scale for Thermometer

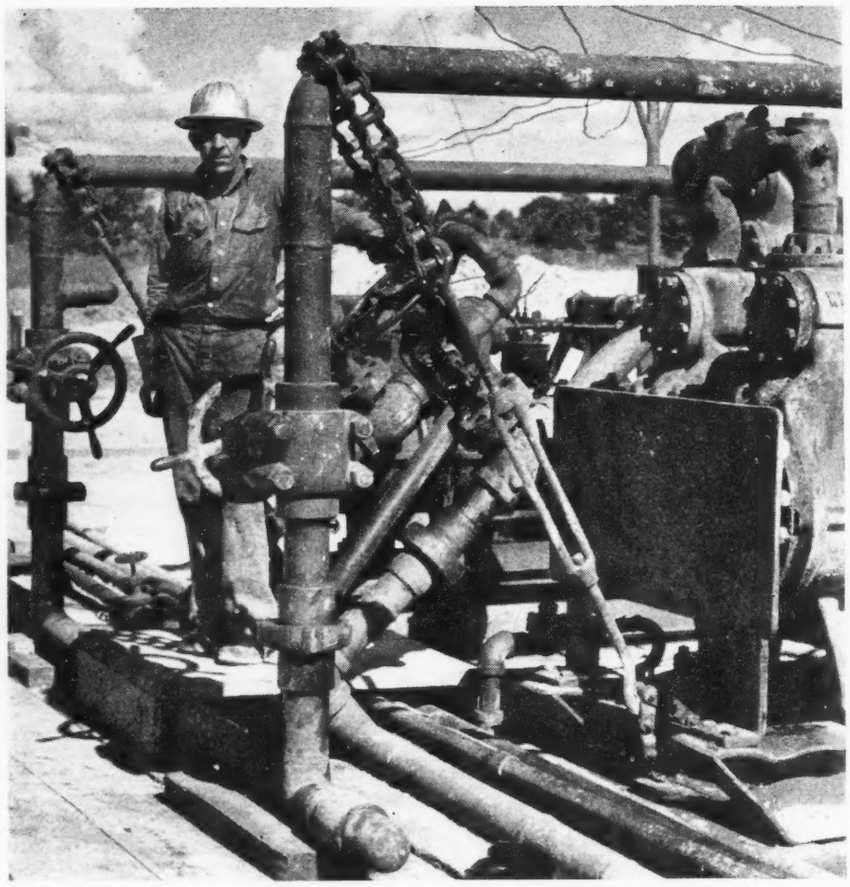
WE HAVE A BOILER THAT OPERATES at 400 lb per sq in. pressure and a total steam temperature of around 575 F. Since the temperature of 400-lb saturated steam is approximately 450 F, our normal superheat is 575—450=125 F. The superheat, however, varies over quite a wide range, and to get it we deduct 450 from total temperature. To simplify this we put a second scale on the thermometer that gives the superheat directly, as in the figure.



Alamosa, Colo. WILLIAM P STEEN

Level Alarm for Turbine Oil System

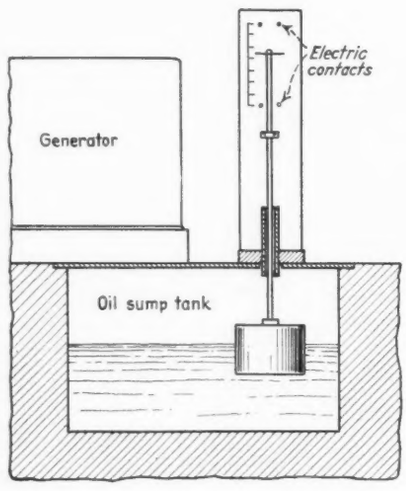
OUR TURBINE LUBRICATING-OIL PUMP is located where it is difficult to inspect and maintain, and cannot be seen by the turbine operator. This pump, which is a direct-acting reciprocating steam unit, pumps oil from the sump to an elevated tank, where it flows by gravity to the turbine bearings. The speed of the pumps is automatically controlled by a valve in the steam line positioned by a float in the lubricating-oil tank.



Tie-Down Absorbs Pump Pounding

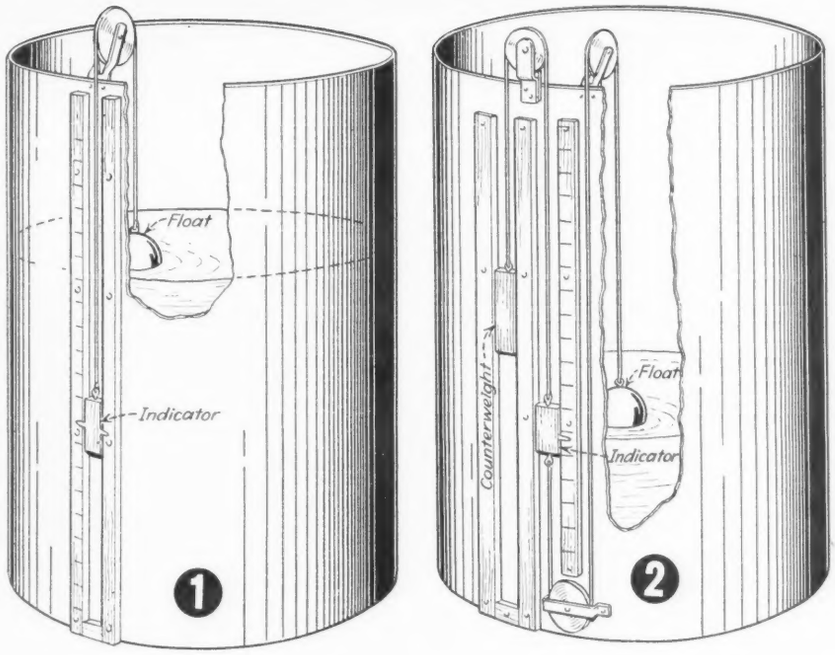
THE DISCHARGE LINE FROM A DUPLEX-PLUNGER PUMP, operating at pressures up to 1200 lb per sq in. vibrated at certain speeds and pressures. There was a possibility that this vibration would produce stresses and break the joints in the piping system. To prevent this and also to counteract the effect of the high pressure to straighten out the bends in the system, we installed a short length of heavy chain around each joint and attached it to the pump base by a turnbuckle, as in the photo. By taking up on the turnbuckle we can draw the line tightly against its supports, and dampen any vibration before it reaches a dangerous condition. The chain is held in place at the pipe elbow by bosses spot welded on the outside of the elbow spaced to fit between chain links.

Houston, Texas CHARLES C LYNDE



On two occasions the oil pump stopped without the operator noticing it until a bearing wiped. To correct this condition we installed a lamp on the log desk and arranged its circuit with a contact that is opened and closed by movement of the pump's piston rod. As long as the pump operates the lamp flashes, but if it stops the lamp will show bright or dark continuously depending on the position of the piston.

As a further precaution we installed an indicator and an alarm on the oil-sump. We drilled a hole in the sump cover and welded a pad over it. This pad was tapped for a $\frac{3}{8}$-in. pipe to act as a guide for a rod on a float placed in the oil sump, as in the figure. On



Water-Level Indicator for Elevated Tanks

A COMMON FORM OF WATER-LEVEL INDICATOR for tanks is shown in Fig. 1. With this arrangement the indicator moves in the opposite direction to the water level. When the tank is full the indicator is at the bottom and when empty is at the top.

When we needed a water-level indicator for our elevated water tank we made it so that the indicator moves in the same direction as the water level. Fig. 2 shows how this was done. The chain from the float goes over a sheave, down around another at the bottom of the tank and to the indicator, which connects to the counterweight. It is evident that when the indicator and float are set at the same level they will always move up and down together. When the tank is full the indicator will be at the top with the float and when the tank is empty the indicator will be at the bottom.

Philadelphia, Pa. R O SPENCER

top of the rod we attached a short copper strip at right angles to it. The copper strip serves as a pointer on a scale to show the amount of oil in the sump and also closes contacts at the high and low oil levels to sound an alarm.

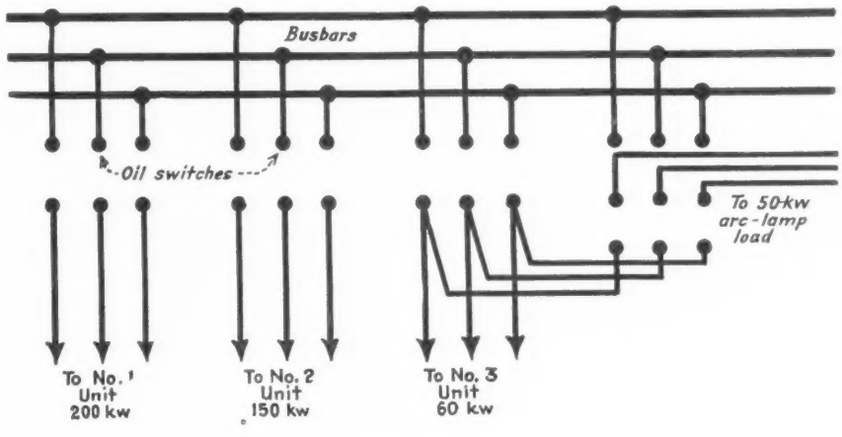
Bronx, N. Y. TYLER C HICKS

Divided Load Solves Parallel Problems

AN ISOLATED POWER PLANT contained two corliss engines belted to a 150- and 200-kw alternator and an automatic-cutoff slide-valve high-speed engine direct-connected to a 60-kw alternator. Parallel operation with the small engine was practically impossible because this unit tended to hog the load from the other machines.

Part of the load on the plant was a 50-kw series arc-lamp circuit. We installed a double-throw switch, as in the diagram, so that during peak loads the arc lamps could be connected to the small generator. During normal operation we connected the arc-lamp circuit to the busbars and shut down the small unit. This solved the peak-load problem and also permitted connecting any of the generators to the busbars, when a single unit would carry the load.

Duluth, Minn. E R WEBER



New Piping Source of Boiler-Oil Trouble

FOR A NUMBER OF YEARS we experienced difficulty with oil in our boilers. Although this oil was not responsible for any serious trouble there was always the fear that it might at some time. In attempting to eliminate this condition every reasonable precaution was taken to prevent oil entering the piping system. Oil separators in the exhaust lines from reciprocating steam pumps—the only reciprocating equipment in the plant using steam—were checked continuously to be sure they were properly drained and operating efficiently.

When this procedure failed to keep oil out of the boilers the pump exhaust lines were disconnected from the low-pressure steam system, the exhaust condensed in a hot-water heater and the oily condensate wasted. Even after this was done indications of oil were again discovered in the boiler drums.

Finally after much investigation the source of the oil was discovered. Our piping system is extensive and furnishes steam for heat and process use to numerous buildings scattered over a wide area. In addition to being extensive it is old and requires a great many renewals. It was found that oil from renewal piping in various forms, that is, thread-cutting coolant, pipe-joint compound and surface oil on the new pipe itself was coming back to the boilers.

After instructions had been issued that all new piping must be blown out thoroughly or if possible allowed to drain to waste for several days before it was connected into the main condensate-return system, no further indications of oil appeared in the boilers.

Roanoke, Va. S H COLEMAN

Steam Table Drills—No. 2

Heating Water—Making Steam

By PHIL SWAIN

IN DEFINING "ENTHALPY" last last month I made a slight error. I indicated that the enthalpy of saturated liquid water at 170 lb absolute pressure is exactly equal to the heat that must be supplied to warm one pound of water from 32 F to the saturation temperature (368.41 F) if the water is subjected to a pressure of 170 lb per sq in. absolute, throughout the heating. Actually the enthalpy is all this *plus* the heat equivalent of the pumping work required to force the 32-F water under the loaded piston at the start of the process.

This correction doesn't amount to much (only about ½ Btu in this case), but I mark it down to set me right with the thermodynamic experts.

In the old days we never had much trouble figuring the amount of heat required to warm one pound of water from one temperature to another. We never paid any attention to the pressure and often figured the heat added by merely subtracting the low temperature from the high. That is, we figured it took 300 Btu to heat one pound of water from 100 to 400 F.

When we wanted to be precise we picked the two enthalpies out of the steam tables and took the difference. Using our modern tables, this gives 374.97 − 67.97 = 307 Btu, or 7 Btu more than the straight difference of the temperatures in this particular example.

The answer figured this last way will be good enough for most practical men today, but again is open to question by the experts. They will point out that the difference of the enthalpies is not exactly the net heat required unless the heating is performed under certain special pressure conditions not often existing.

The more I try to explain this, the more confused the reader will get, so here is my advice to the practical man who is not concerned with the hair-splitting battles of the experts, but merely wants to use the steam tables for ordinary garden-variety figuring:

Forget all the refined definitions of the "enthalpy of the liquid." Take it to be merely the heat required to warm the liquid from 32 F to the given temperature, regardless of the pressure. This rule will be close enough for most practical purposes if the pressure does not exceed 500 lb per sq in. absolute.

In the case of "enthalpy of vaporizations," the precise definition is the same as the practical one: "Heat added to convert one pound of saturated liquid water into saturated vapor at the same pressure and temperature."

"Enthalpy of saturated vapor" will be the sum of the enthalpy of the liquid and that of vaporization. It is what used to be called "total heat of saturated steam."

"Enthalpy of superheated vapor" is the enthalpy of saturated vapor at the same pressure plus the additional heat required to superheat the saturated vapor.

Disregarding the fine points already mentioned, the following rule is good enough for ordinary engineering work at pressures under 500 lb:

To convert water at any temperature into water at higher temperature, or into steam at any condition, the heat required is equal to the final enthalpy minus the initial.

Problem 1—*How much heat is required to heat one pound of water from 94 F to 202 F?*

SOLUTION:

Enthalpy liquid at 202 F	170.00 Btu (Fig 1)
Enthalpy liquid at 94 F	61.98 Btu (Fig 1)
Heat supplied (diff)	108.02 Btu

Problem 2—*How much heat is required to convert one pound of feed water at 208 F into saturated steam at 174 lb per sq in. absolute pressure?*

SOLUTION:

Enthalpy sat. steam	1196.4 (Fig 2)
Enthalpy feed water	176.04 (Fig 1)
Heat supplied (diff)	1020.36 Btu

(*To be continued in March* POWER)

All references to steam tables in this series are to the "Thermodynamic Properties of Steam" (1936 Edition), by Keenan and Keyes, published by John Wiley & Sons, Inc, New York. Sections reproduced by permission of the publishers.

Table 1. Saturation: Temperatures

Temp. Fahr.	Abs. Pressure Lb. Sq. In.	Abs. Pressure In. Hg.	Specific Volume Sat. Liquid	Specific Volume Evap.	Specific Volume Sat. Vapor	Enthalpy Sat. Liquid	Enthalpy Evap.	Enthalpy Sat. Vapor	Entropy Sat. Liquid	Entropy Evap.	Entropy Sat. Vapor	Temp. Fahr.
t	p		v_f	v_{fg}	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	t
90°	0.6982	1.4215	0.01610	468.0	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087	90°
91	0.7204	1.4667	0.01611	454.4	454.4	58.99	1042.4	1101.4	0.1133	1.8927	2.0060	91
92	0.7432	1.5131	0.01611	441.2	441.3	59.99	1041.8	1101.8	0.1151	1.8883	2.0034	92
93	0.7666	1.5608	0.01611	428.5	428.5	60.98	1041.2	1102.2	0.1169	1.8838	2.0007	93
94	0.7906	1.6097	0.01612	416.2	416.2	61.98	1040.7	1102.6	0.1187	1.8794	1.9981	94
200°	11.526	23.467	0.01663	33.62	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762	200°
202	12.011	24.455	0.01665	32.35	32.37	170.00	976.6	1146.6	0.2969	1.4760	1.7729	202
204	12.512	25.475	0.01666	31.14	31.15	172.02	975.4	1147.4	0.2999	1.4697	1.7696	204
206	13.031	26.531	0.01667	29.97	29.99	174.03	974.2	1148.2	0.3029	1.4634	1.7663	206
208	13.568	27.625	0.01669	28.86	28.88	176.04	972.9	1148.9	0.3059	1.4571	1.7630	208

Fig 1—Extract, Table 1, Keenan & Keyes, "Saturation: Temperatures"

Table 2. Saturation: Pressures

Abs. Press. Lb. Sq. In.	Temp. Fahr.	Specific Volume Sat. Liquid	Specific Volume Sat. Vapor	Enthalpy Sat. Liquid	Enthalpy Evap.	Enthalpy Sat. Vapor	Entropy Sat. Liquid	Entropy Evap.	Entropy Sat. Vapor	Internal Energy Sat. Liquid	Internal Energy Evap.	Internal Energy Sat. Vapor	Abs. Press. Lb. Sq. In.
p	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	u_f	u_{fg}	u_g	p
170	368.41	0.01822	2.675	341.09	854.9	1196.0	0.5266	1.0324	1.5590	340.52	771.4	1111.9	170
172	369.35	0.01823	2.645	342.10	854.1	1196.2	0.5278	1.0302	1.5580	341.52	770.5	1112.0	172
174	370.29	0.01824	2.616	343.10	853.3	1196.4	0.5290	1.0280	1.5570	342.51	769.7	1112.2	174
176	371.22	0.01825	2.587	344.09	852.4	1196.5	0.5302	1.0259	1.5561	343.50	768.8	1112.3	176
178	372.14	0.01826	2.559	345.06	851.6	1196.7	0.5313	1.0238	1.5551	344.46	767.9	1112.4	178

Fig 2—Extract, Table 2, Keenan & Keyes, "Saturation: Pressures"

SHORT QUESTIONS QUICK ANSWERS

All Around The Plant

Q—Name two ways in which alternating current can be transformed into direct current.

A—Alternating current can be transformed into direct current either by a rotary converter or a rectifier.

Q—Why are generators over-compounded?

A—They are over-compounded so that the terminal voltage will increase as the machine load increases. This over-compounding or raising of the terminal voltage prevents low voltage at the load center caused by line drop from heavy feeder loads.

Q—What is meant by 95% steam?

A—In a quantity of "wet" steam (a mixture of steam and water) the percentage of dry steam, expressed as a decimal, is called the quality of the steam. Steam that contains 5% or .05 moisture would be classed as having 95% dry steam.

Q—How many Btu would be required to change 1 lb of ice at 32 F to water at the same temperature?

A—*Temperature of fusion* is the temperature at which a solid changes to a liquid, or a liquid changes to a solid. The fusion temperature of ice is 32 F. At this temperature it requires 144 Btu to change 1 lb of ice to water; this is the *latent heat of fusion.*

Q—What is the difference between a revolution counter and a tachometer?

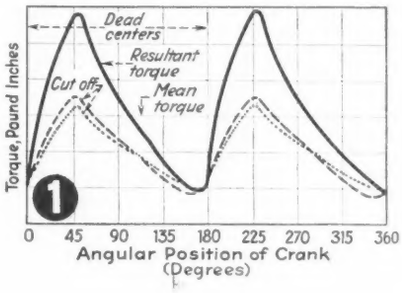
A—A revolution counter is used to measure total revolutions without considering the time element. When used to measure rpm the revolutions must be counted for the duration of one minute. A tachometer registers the rpm directly on its dial.

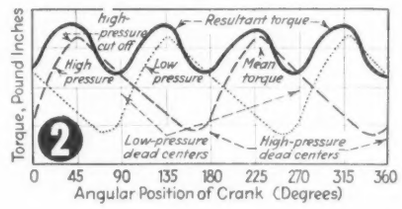
Q—How many gallons of water per minute will flow through a pipe having an area of 2 sq in., velocity of flow being 450 ft per minute?

A—A velocity of 450 ft per min is equal to 12 × 450 or 5400 in. per min. With a pipe having an area of 2 sq in. this results in 2 × 5400 or 10,800 cu in. of water flowing per minute. As there are 231 cu in. in one gal, $10,800 \div 231 = 46.7$ gpm flowing through the pipe.

Q—Is it necessary to have a receiver on a cross-compound engine? Why? Could you run without one?

A—The determining factor regarding the installation of a receiver is the position of the cranks in relation to each other. In a cross-compound engine the cranks are generally located 90 deg apart. Having the cranks with this relation to each other gives a more uniform torque than is the case when the cranks are 180 deg apart.





This is quite apparent from a study of the torque curves of a tandem and cross-compound engine. With compound engines having crank positions such that one piston is at mid-stroke when the other is at the end of its stroke a receiver is always needed. This arises from the fact that the high pressure cylinder does not exhaust at the proper time to supply the low-pressure cylinder with steam. With engines in which the pistons all arrive at their mid-stroke at the same instant no receiver is required other than the capacity of the supply pipe between cylinders. This is the condition in a tandem-compound engine where the pistons arrive at mid-stroke together and the high-pressure cylinder discharges directly to the low-pressure cylinder.

A cross-compound engine with cranks 90 deg apart cannot be operated without a receiver of some sort. The minimum size of a receiver recommended is from one to one and one half times the volume of the high-pressure cylinder. In many cases the volume of the connecting pipe may be sufficient to pass this minimum requirement, but the installation may not produce efficient results.

Q—What hp is being developed by an engine under a prony brake test if the scales show 200 lbs length of arm is 5 ft, and engine is running 200 rpm? Neglect weight of arm and bearing friction.

A—Formula for brake horse power:

$$BHP = \frac{2\pi \times L \times N \times W}{33000}$$

L = length of lever arm.
N = number of RPM
W = force in lb as registered on scales.

Then

$$\frac{2\pi \times 5 \times 200 \times 200}{33000} = \frac{1,256,000}{33000}$$

or 38 hp

Ed Note: The point of contact, of the lever arm with the scales, should be level with the center of engine shaft in order to measure correctly the force acting at right angles.

Q—Has it ever been proved that compression is more or less beneficial to coal piles? If so, in what way?

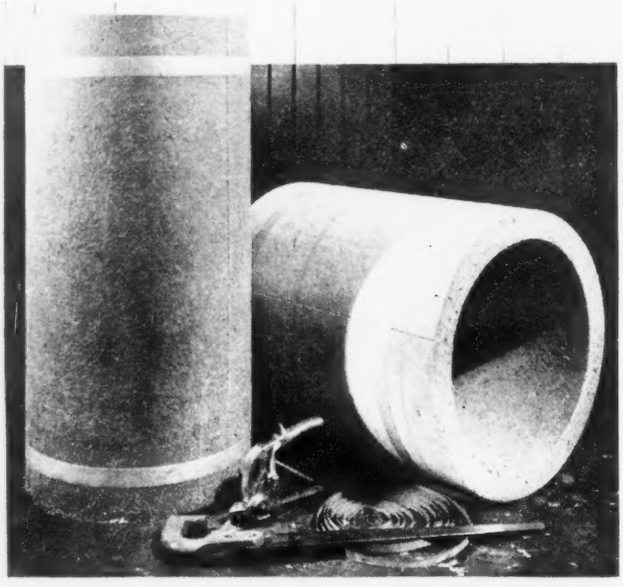
A—It is a well-established fact that spontaneous combustion occurs in coal piles if the air circulated through the pile is insufficient to keep it cool, but sufficient to support combustion. When coal is piled in the usual way the fine particles remain near the center and the larger ones roll off to the side. This leaves air between the various sized lumps which is sufficient to support combustion, but has no cooling action because there is no circulation with the outside atmosphere.

A compressed coal pile is one that is built up in layers 5 to 12 in. thick so that all voids between lumps are filled with fine particles. This method excludes air from the pile and retards spontaneous combustion.

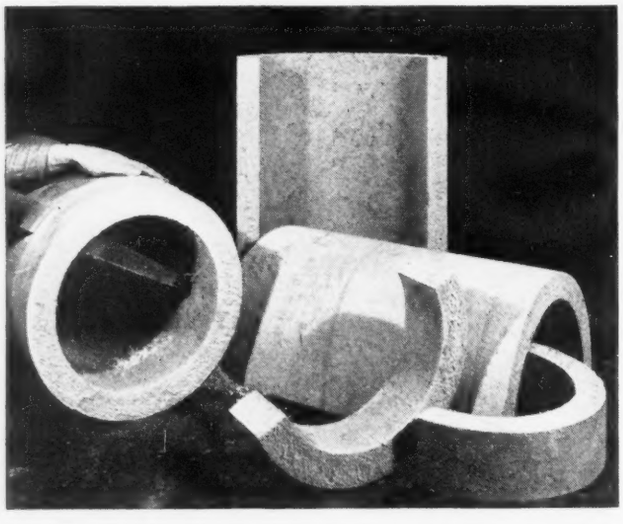
HOW TO INSULATE FLANGES

MAKING REMOVABLE FLANGE COVERS from sectional pipe covering is quick, efficient and requires only a saw and metal bands. Such covers are readily removable without damaging the material and can be replaced on the flange without showing ugly marks.

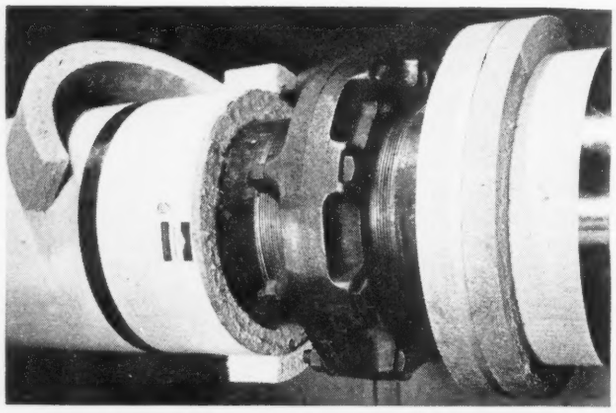
Photos by courtesy of Union Asbestos & Rubber Co



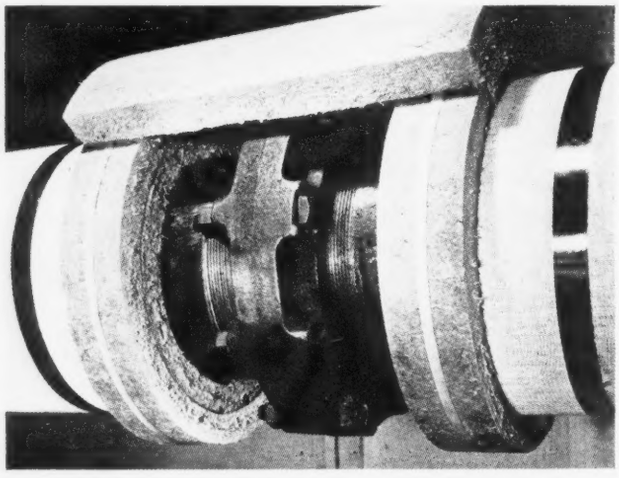
1 Materials and equipment required are (1) a supply of pipe covering with an inside diameter the same as outside diameter of pipe insulation, (2) a supply of sectional pipe covering with an inside diameter the same as the outside measurement of (1) and slightly larger than the flange diameter, (3) an ordinary saw preferably with minimum set and having 14–16 points per inch or an 18–22-point hack saw, (4) a tape-banding set and supply of metal tape



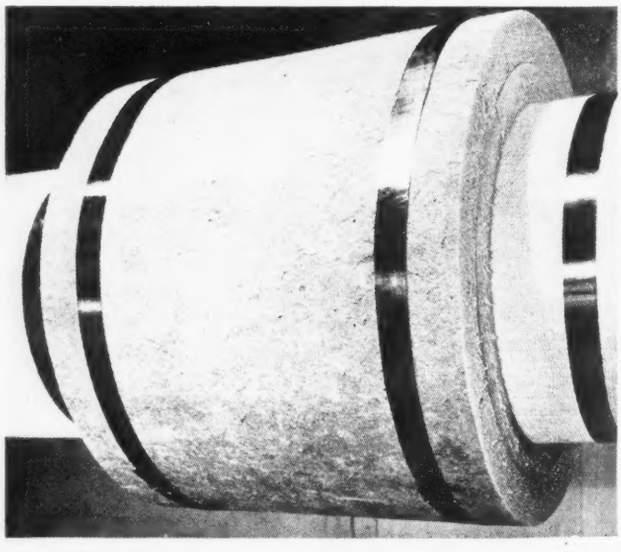
2 Saw short lengths of pipe covering to fit over ends of pipe insulation on each side of flange. A fine saw is preferable because it does not tear the fibrous material of the sectional pipe covering



3 Fit the sections over the pipe insulation at any convenient distance from the flange and band in place



4 After the foundation is built, cover flange and short sections with larger pipe covering cut to length



5 Finished joint cover is neatly banded in place. The flange is now covered with an insulating material approximately equal to that of the rest of the pipe. Cover can be removed and replaced as many times as required for replacing gaskets or other maintenance operations

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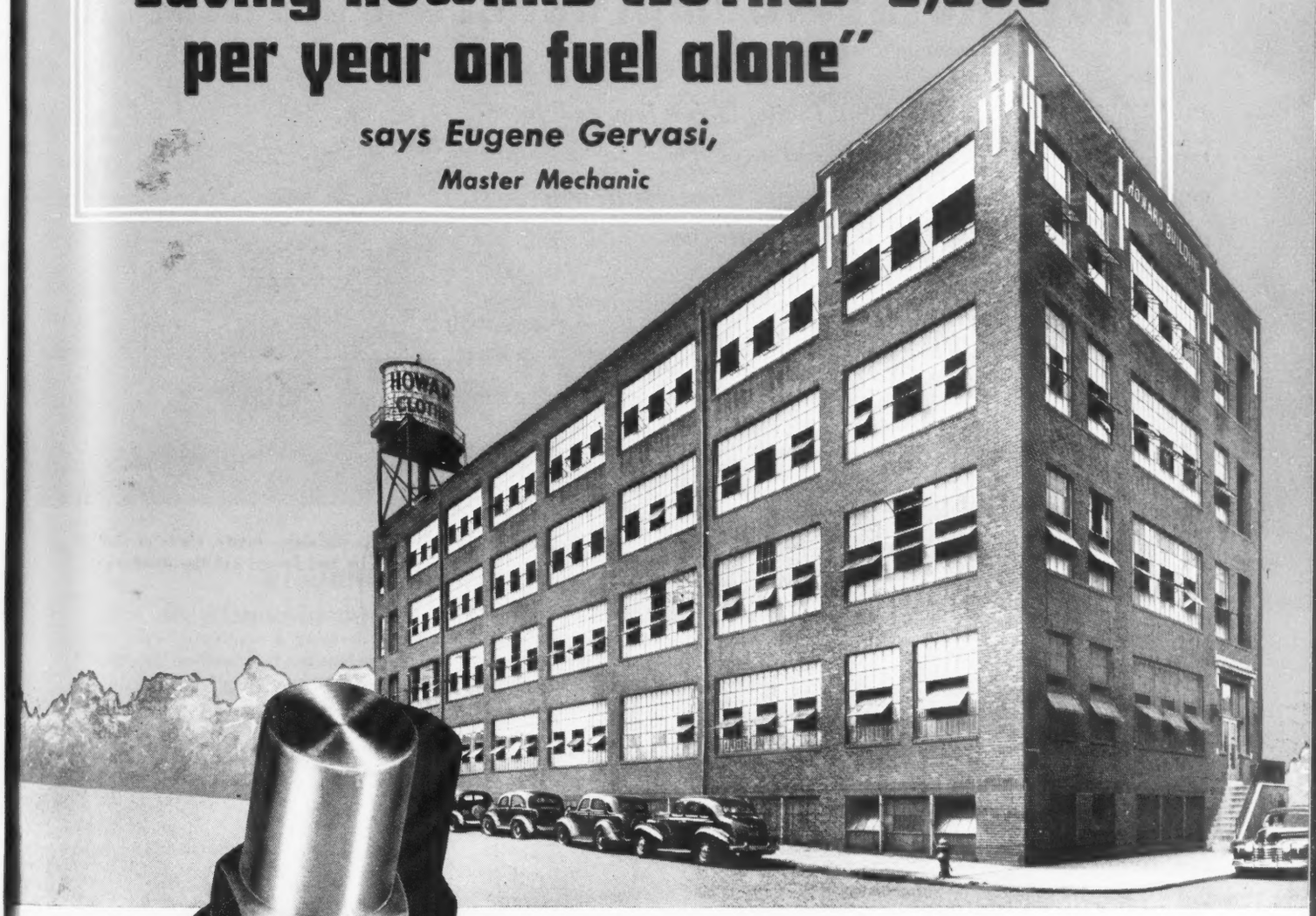

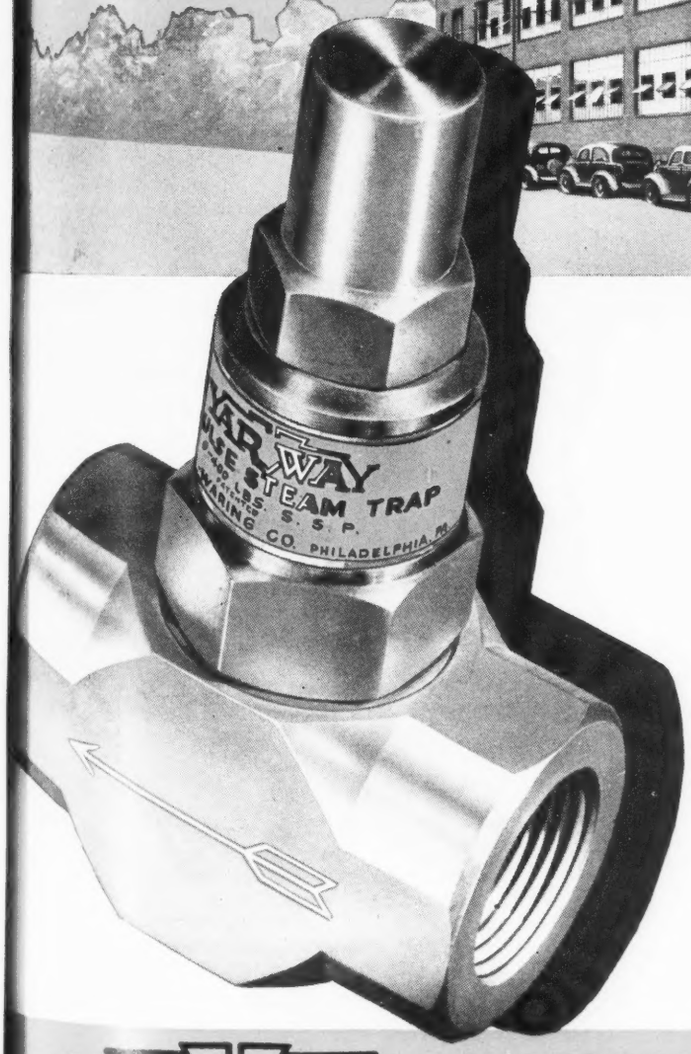

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YARWAY IMPULSE STEAM TRAP

How Rotary Compressors Operate

Positive-displacement units are available for low and intermediate pressures (to 100 lb and over) and for medium capacities (to 12000 cfm and over). This article describes sliding-vane, 2-impeller and liquid-piston types

▶ ROTARY COMPRESSOR APPLICATIONS overlap those of centrifugal units. Centrifugal compressors have been built for pressures from one to above 100 lb and in capacities over 130,000 cfm; rotary compressors have been built for pressures up to and above 100 lb and capacities above 12.000 cfm.

The ASME test code classifies rotary compressors as: *sliding vane*, in which longitudinal vanes slide radially in a rotor mounted eccentrically in a cylinder, Fig. 1; *2-impeller*, in which two mating lobed impellers revolve within a cylinder, Fig. 2; and *liquid piston*, in which liquids are used to displace the air or gas within a single rotating element, Fig. 4.

Sliding-vane units are made for pressures as high as 125 lb and capacities up to 2000 cfm. Generally, single-stage machines are used for pressures up to 50 lb and 2-stage machines for higher pressures. Operating speeds vary from 3600 rpm for small to 450 rpm for large units.

This machine consists of a cylindrical casing in which a cylindrical rotor, smaller in diameter than the casing bore, is arranged eccentrically. A number of radial slots are cut along the entire length of the rotor, which hold the sliding vanes. In some units these vanes are made of metal and in others they are non-metallic. As the rotor revolves, the sliding vanes are thrown

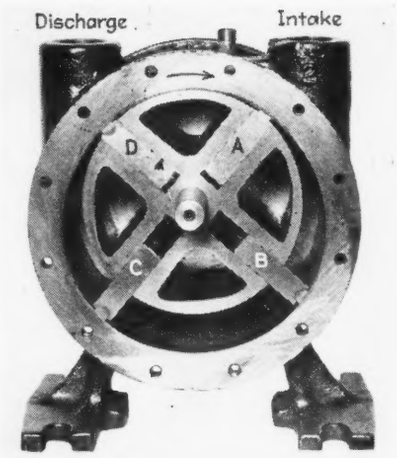


Fig. 1—As the vanes rotate, air is carried in the cells and forced out the discharge

out by centrifugal force, by pins, or by springs, forming a number of cells in the space between the rotor surface, the two vanes and the casing wall. Because of the eccentric rotor position, the cells vary in capacity during each revolution from a maximum to a minimum, and again to a maximum. Air enters the cell between vanes *A* and *B*, Fig. 1; as the vane *A* passes the inlet, the trapped air is carried around to the discharge port. The air is then forced out the discharge as the cell area is decreased.

To reduce wear, the vanes in some

(*Continued on page* 116)

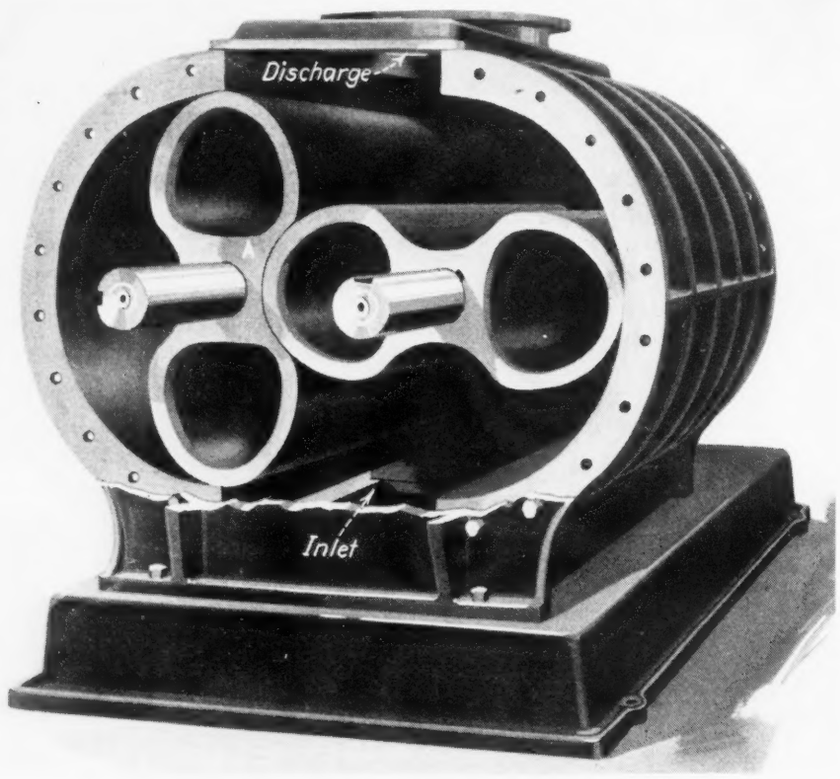


Fig. 2—Two-lobe impellers rotate in opposite directions carrying the air in pockets formed by the inside of the casing and the impeller ends

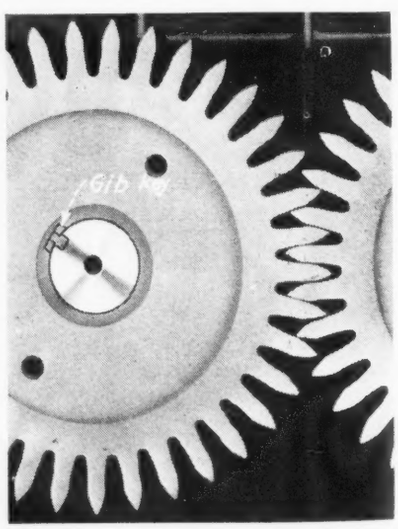
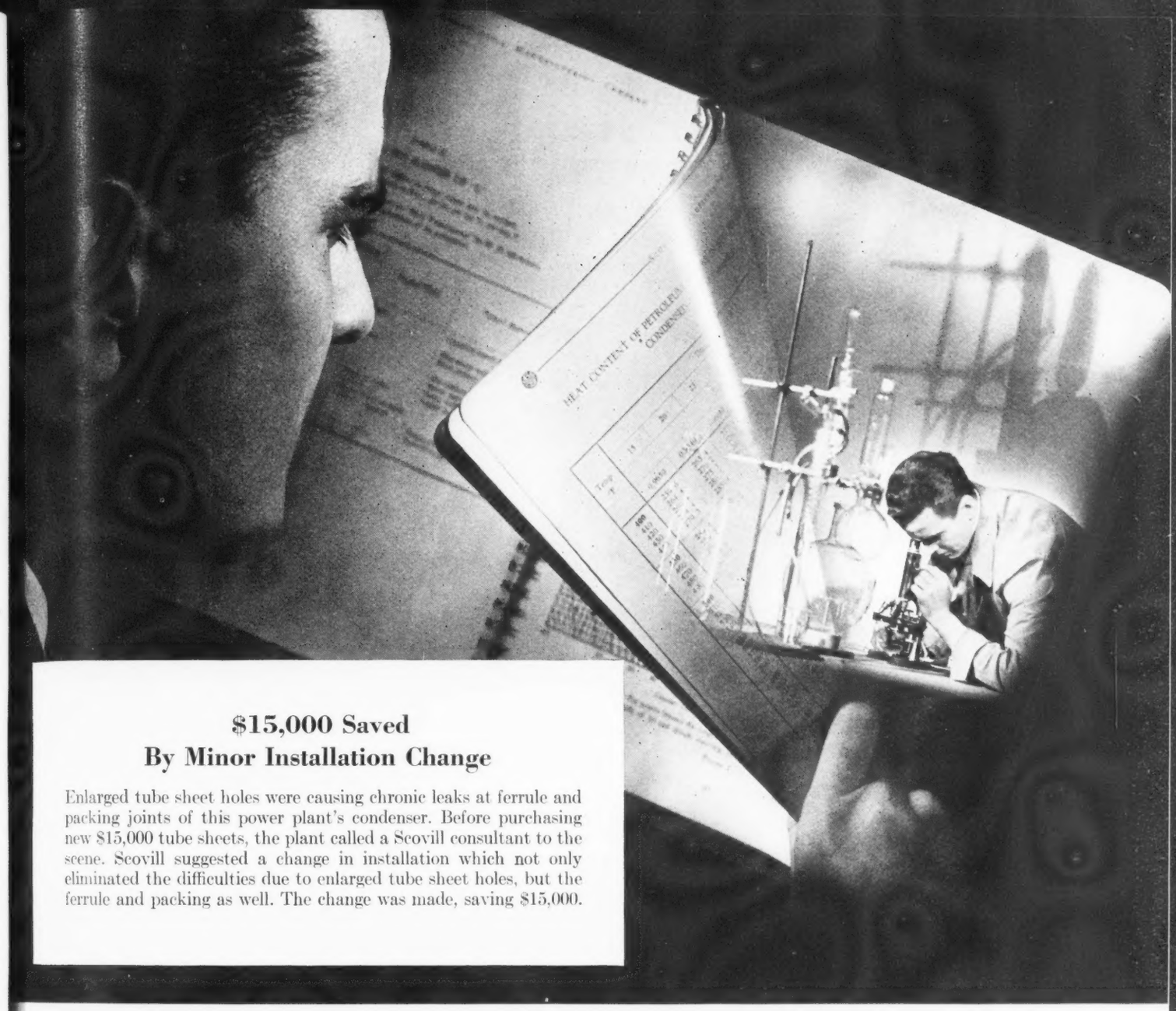


Fig. 3—Gib key allows gear adjustment to maintain clearance between impellers of Fig. 2



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How Rotary Compressors Operate

(Continued from page 114)

machines do not bear on the casing wall. Instead, floating rings having an inner diameter slightly less than the casing bore are used. The vanes bear on these rings and cause them to rotate with the rotor and vanes. The outer surface of the floating rings is separated from the casing by a small clearance.

Two-Impeller Units

Two-impeller positive rotary compressors are primarily suited to pressures from 10 to 15 lb, and for higher pressures by operating single units in series. In Fig. 2, impeller *A*, rotating in a clockwise direction, is in a position where its bottom tip has just cut off the opening to the inlet port, and the top tip is ready to open to discharge.

Air is trapped between the left-hand side of the impeller and the casing, which is not open to either the suction or discharge. As the impeller continues to rotate, its top tip opens the discharge and the bottom tip pushes the inclosed air into the discharge system. The action is repeated twice for each impeller revolution or four times for each turn of the driving shaft. The speed determines the capacity in cubic feet of air delivered, while the generated pressure is that needed to force the air into the main distribution system.

Because there are no internal rubbing surfaces in this design no internal lubrication is required; air is therefore delivered free of oil. As clearances must be maintained between the lobes, provision must be made in the driving-gear arrangement so that the gears can be adjusted for teeth wear. The gib key, shown in Fig. 3, permits accurate location of the lobes with relation to each other and obviates the necessity of using an offset key to shift the gear when setting the lobes or taking up tooth-surface wear.

Liquid-Piston Units

Liquid-piston compressors can produce pressures up to approximately 75 lb in a single stage. Two-stage units are available for higher pressures. This machine consists of a multi-blade rotor revolving freely in an elliptical casing partially filled with liquid. The curved rotor blades, Fig. 4, project radially and form, with their supporting side shrouds, a series of pockets or cells around the rim. Rotation at a high speed throws the liquid out from the center by centrifugal force, resulting in a solid ring of liquid revolving in the

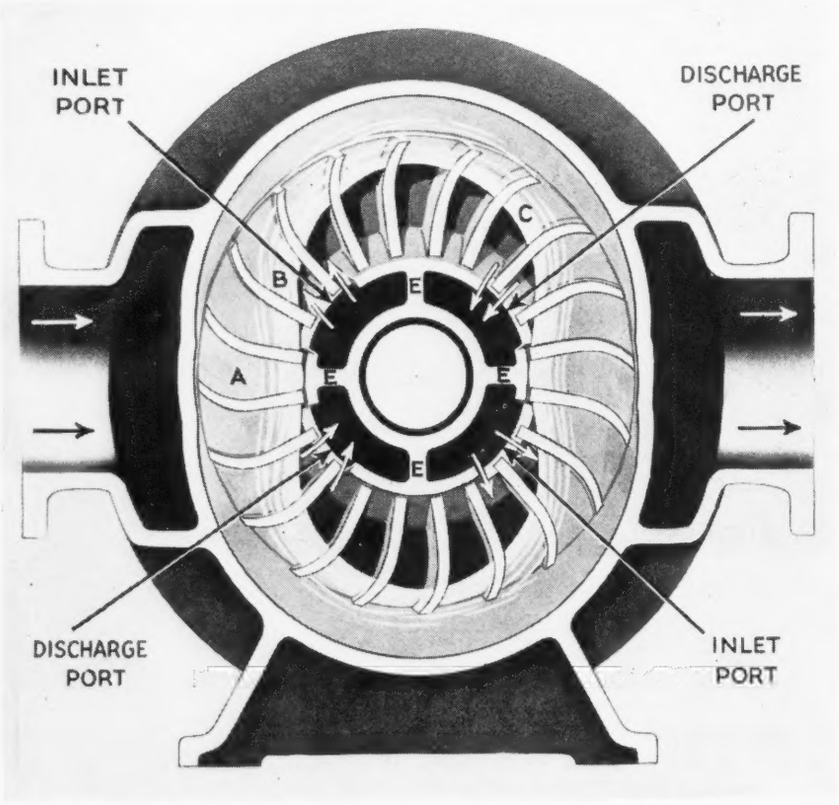


Fig. 4—Centrifugal force applied to a liquid acts as the compressing agent

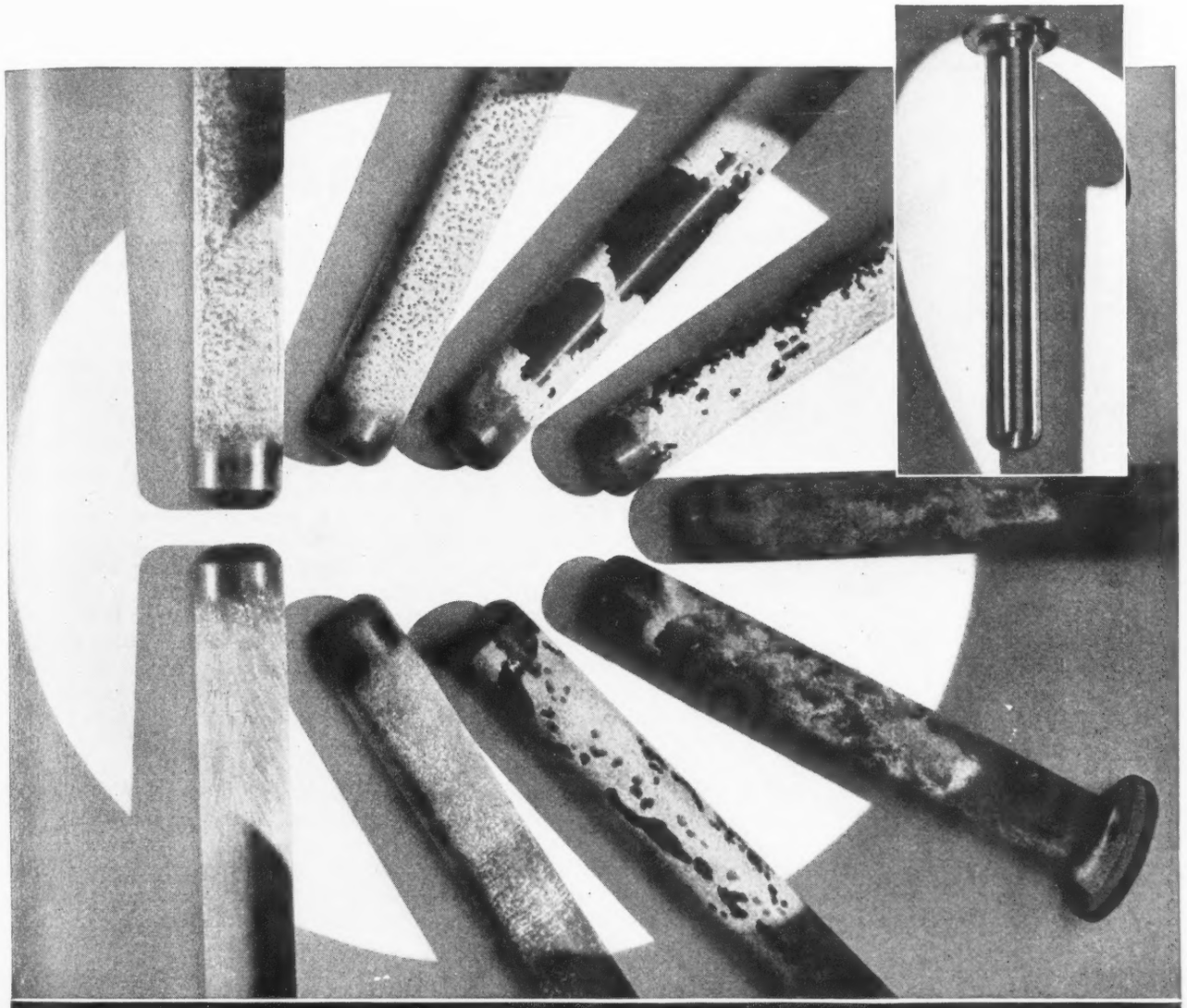
casing at the same speed as the rotor, but following the elliptical contour of the casing. This alternately forces the liquid to enter and recede from the cells in the rotor at high velocities, as in Fig. 4. The 4-pocket chamber *E*, containing the inlet and discharge ports, surrounds the shaft and is cast integral with one end bell and is stationary. The impeller blades, held and supported by a shroud ring, revolve as a unit around this chamber. Starting with a cell at point *A*, which is now filled with liquid and moving in a clockwise direction, we can follow its movement. As the cell moves over the inlet port *B*, centrifugal force causes the liquid to leave the cell and the air to take its place. This action continues as the cell moves until it is filled with air, which it carries along until it reaches point *C*. Here the restricted space causes the liquid to reenter the cell, forcing the air out the discharge port. This operation repeats itself twice for each revolution of the impeller. A small quantity of liquid is supplied continuously to remove the compression heat. Any surplus is discharged with the air and is removed by a baffle separator.

The axial clearance in rotary compressors between ends of the rotor and casing head is extremely small and is just sufficient for expansion caused by the heat of compression. The rotor must be free to find its own center between the heads. For this reason it is important that there be enough clearance between the coupling flanges and disks so that the driving shaft will not exert any thrust on the compressor shaft. If for any reason the casing head should be removed, the same thickness of gaskets must be used in reassembling to insure correct clearance. Compression of material must be considered when measuring gasket thicknesses. Excessive end clearance will cause reduced capacity because of increased slippage.

Efficiency

Efficiency depends largely on the amount of friction and slip. Slip is the leakage back to the inlet side which occurs because of clearance between the casing and rotating parts. The quantity of air or gas leaking back can be shown as cfm, but for convenience is usually expressed in rpm. Thus it can be said that the slip in rpm is the number of revolutions the machine must make to

(*Continued on page* 118)



SPOTLIGHT ON *Destruction*

SCALE can mean eventual boiler destruction, and the time to stop it is *before* it forms on expensive power plant equipment. These tubes, taken from high pressure miniature test boilers in the Nalco Laboratories, spotlight corrosion and incrustation destruction. Study of the deposit formed here with samples of your feedwater is one important means used by Nalco Engineers in preventing damage and inefficiency in your plant equipment.

Costly experimentation with feedwater treatments has no place in plants using the Nalco System. From a thorough Nalco Survey, your plant is provided with a "made-to-measure" system that is permanent insurance against all water treatment difficulties. Write for full information.

Above: *Sample tubes from the Nalco Laboratories, showing a variety of dangerous scale formations.*

Inset: *A clean, new boiler test tube, ready to tell the whole truth about your feedwater, and what it does to your boiler tubes.*

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place **Chicago, Illinois**

Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

The Complete Water Treating Service

Nalco

How Rotary Compressors Operate

(Continued from page 116)

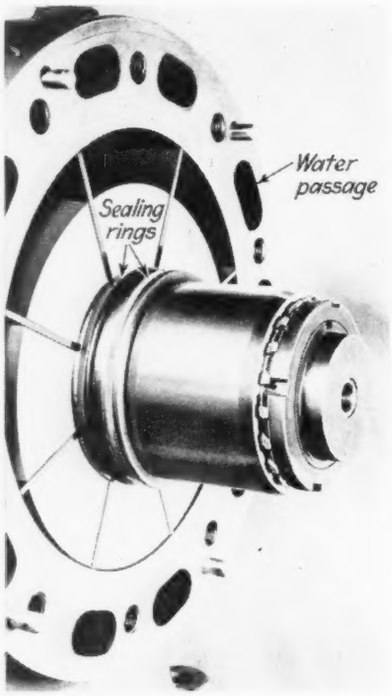


Fig. 5—Cooling water in passages cast in cylinder wall carries compression heat away from the machine

hold the pressure against leakage or to make up for leakage air. Some authorities state that the slip will vary as the square root of the pressures. This statement is only approximate, because the slip in some machines is more than in others. Pressure and speed control the slip to a great extent as is apparent by the efficiency curves in Fig. 6. A machine developing a given pressure at low speed has a greater slip than it would have if operated at higher speed at the same pressure.

Safety Precautions

Excessive overpressures are possible with rotary units and relief valves must be installed on the discharge line. Machines of this type are usually equipped with an automatic unloader consisting of a spring-loaded air-operated piston valve, which is controlled by a pilot valve. The pilot valve is arranged so that when a pre-determined maximum pressure is reached, the suction valve is closed. Simultaneously a check valve in the discharge line closes and a bypass opens from the discharge to the suction line, which unloads the compressor completely. When the pressure reaches a set minimum the sequence is reversed, and the compressor again delivers. When the excess air or gas is returned to the inlet side a cooler should be provided in the bypass line to prevent overheating. With small motor-driven units the automatic unloader may be omitted and a pressure-operated motor starter used. The unit will then be started or shut down as air requirements dictate.

Lubrication

The lubrication requirements are special for each machine and the manufacturer's instructions should be followed carefully. Internal lubrication is generally supplied by means of manually or automatically controlled oilers, mechanical force-feed lubricators, grease cups, or grease-gun fittings. Unlike internal-combustion engines, the lubricant fed into the cylinder of the rotary compressor is not burned, and if of high quality the amount vaporized is small. Consequently only a small quantity is required to maintain an effective lubricating film on the interior surfaces. The most reliable method of determining whether or not the feed is correct is by inspecting the compressor interior. If the surfaces are dry and show signs of rust, the feed is too small and should be increased; if lubricant has accumulated in the ports and clearance spaces, the feed is excessive and should be reduced. If all parts show a uniform and just-visible film, the feed is correct. Lubricants should have the correct viscosity and possess maximum chemical stability.

Compressor cooling arrangements vary with the different manufacturers. The 2-impeller positive type does not require cooling because of its low-pressure discharge. In rotary as well as centrifugal machines, cooling usually begins when the compression is near 35 lb. Fig. 5 illustrates one method of cooling where water passages are cast integral with the casing. Other units have water cooling passages only in the casing heads.

Where the rotating clearance is measured in thousandths of an inch, an air filter on the inlet pipe is an important accessory to prevent entrance of foreign matter. Sand or abrasive material would soon increase the clearance to such an extent as to require frequent repairs if normal output were to be maintained.

Shaft packing methods vary with the different manufacturers and according to the service for which the machine is to be used. Sometimes soft packing is used, while in others a shaft seal ring is utilized; for gas compressors a special design of sealing gland is installed. In some machines only one end of the shaft extends through the casing requiring only one seal. Quite often oil is used with metallic sealing rings to prevent leakage while machine is idle and as a lubricant during operation.

As previously stated no sharp line can be drawn between the field of centrifugal and rotary compressors. Even though the 2-impeller unit is classed as a positive-displacement compressor, its field of application more nearly approaches that of the single-stage centrifugal type than does any of the other rotary compressors. The two remaining types swing, to some extent, to the reciprocating field where higher pressures and lower capacities predominate.

For assistance in preparation of this artice, POWER is indebted to The Compressed Air Institute, Roots-Connersville Blower Corp, Socony-Vacuum Oil Co, Inc, Allis-Chalmers Mfg Co, The Fuller Co, Foster Pump Works, Inc, Nash Engineering Co, The Electric Spravit Co, The Kraissl Co, Lammert & Mann Co, Clark Cooper Co, and Yeomans Brothers Co.

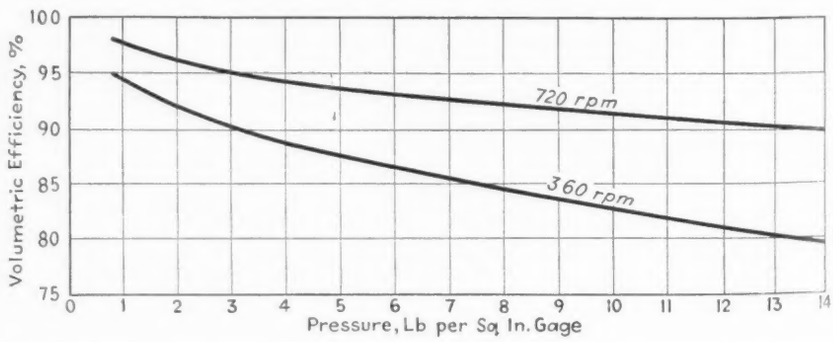
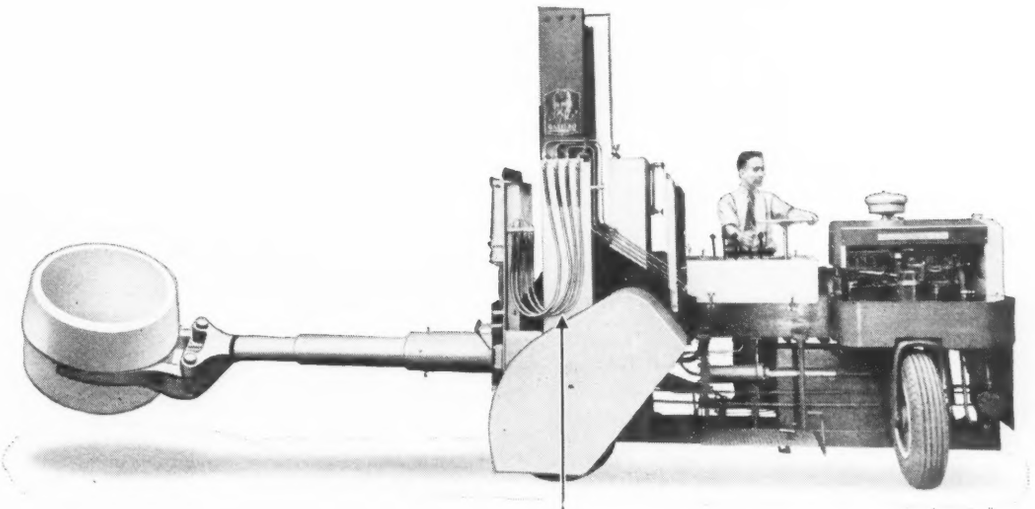


Fig. 6—Lower speed means lower efficiency since, at equal pressures air slip stays practically constant but constitutes a greater proportion of the total flow

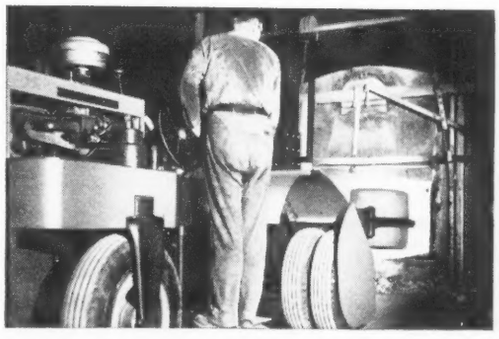


The "muscles" for this mechanical arm have to be more than strong

AMERICAN Seamless Flexible Metal Tubing, carrying hydraulic fluid to actuate the arm of this huge industrial truck, comes in for a tough assignment.

The truck cruises up to furnaces whose temperature is 2600°F., scoops up a molten mass of glass and transports it to rolling mills. The "muscles" are American Seamless—which conveys fluid at 1800 p.s.i. to lower and raise the heavily laden arm while being subjected to the high temperatures at the furnace mouth.

This rigorous service is typical of the jobs that industry has found for tough, pressure-tight connectors of American Seamless, and is typical also of the jobs Uncle Sam has selected for all the products of American Metal Hose. In fact, our government is currently using the major part of our production and will probably continue to do so until victory is assured.



Better Sight for Better Defense—In the famous Bausch & Lomb plants, essential optical instruments for defense work and for defense workers begin in flaming furnaces like this one. Here, a Howell industrial truck with arm actuated through sturdy American Seamless, quickly and efficiently handles molten glass, later to be converted into research instruments, lenses, etc. 42175

ANACONDA
from mine to consumer

American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • GENERAL OFFICES: WATERBURY, CONN.
Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

Power from Butane

High heating value and numerous other advantages make liquefied petroleum gas an almost ideal fuel in areas where it is available. James F Maher, assistant engineer of the butane-fueled Shiprock, New Mexico, power plant, outlines typical applications and characteristics of this gas

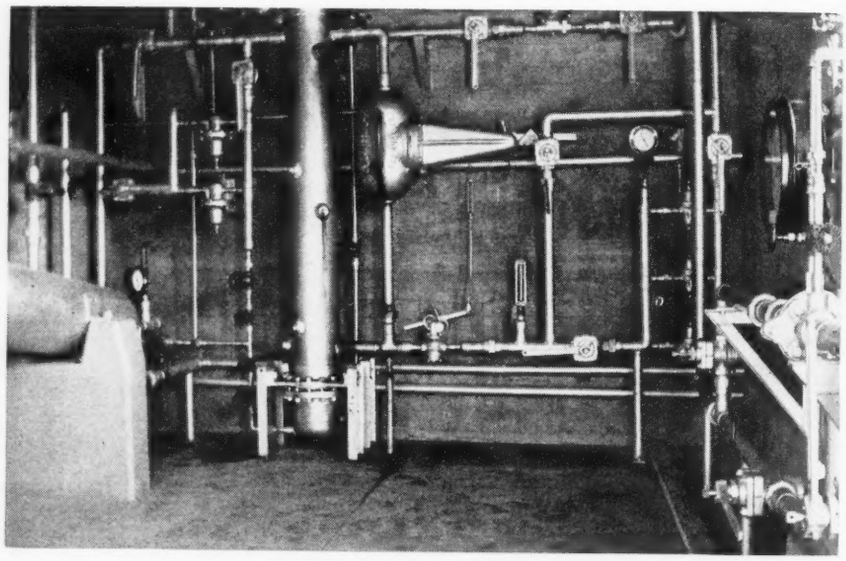
▶ HIGH BTU CONTENT, ease of handling and transportation, low cost, and favorable operating characteristics readily explain the growing use of liquefied petroleum gas (butane-propane) in both stationary and transportation internal-combustion engines, for heating, and for numerous industrial purposes.

Heating value of this gas averages about 100,000 Btu per gal in the liquid state and 3000 Btu per cu ft when vaporized at atmospheric pressure and 60 F (34 cu ft per gal). This compares with about 1000 Btu per cu ft for natural gas. Being held in a liquid state under slight pressure, butane-propane gas may be transported easily, like oil or water, by tank car, by tank truck or by pipeline.

This waste gas from the oil fields was initially marketed in bottles or cylinders, under trade names such as Hydrogas, Congas, and Shellgas. Development of an underground tank system has made it possible to serve larger demands than with the cylinder plan. The usual underground tank of this type holds 1000 gals and is equipped with filling inlet, pressure gage, liquid-level gage and pressure regulator on the outlet line. Location of accessories and control equipment in a compact group in the manhole extension makes everything readily accessible.

Tank Storage

Where the amount of fuel to be used is considerable, above-ground storage tanks of several thousand gallons capacity are used. Rotary pumping units fill the tanks from railroad tank cars or from tank trucks. If liquid is entering or leaving the tanks, the operator cannot secure an accurate measurement of the storage supply by use of gage glasses or slip gages. Experience shows the liquid to be turbulent and the finding of the actual level under these conditions almost impossible. Such measurements must be made with both inlet and discharge tightly closed.



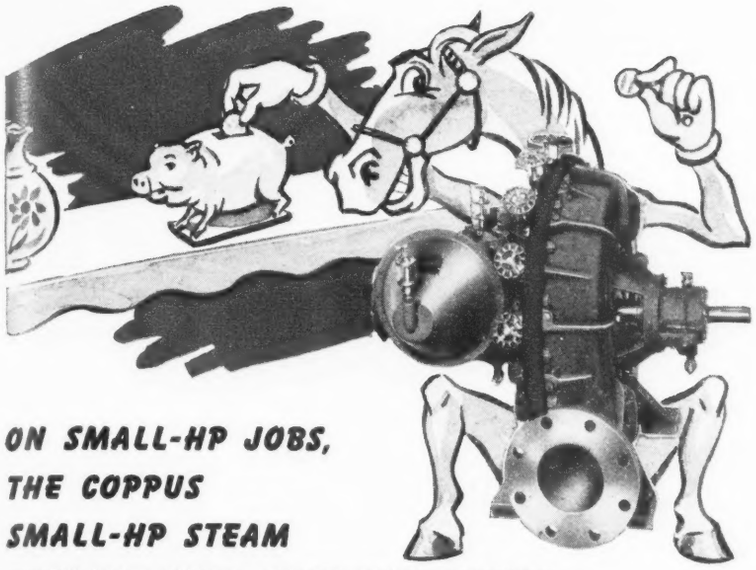
Heat exchanger, regulators and gas piping at the Shiprock power plant

If consumption of gas is small, the heat needed to vaporize the gas can be taken from the atmosphere, but at large rates of flow, this is not enough. Frosting around the control equipment is a sign that excessive heat has been removed from the air. For large units using butane-propane gas, it is customary to supply heat needed for vaporization by means of a heat exchanger. In power plants the source of heat can be the jacket water or the exhaust manifold.

In stationary prime movers, butane-propane gas gives sensitive adjustment to regulation, clean combustion and relatively trouble-free operation (see POWER, Aug 1937, for a description of the Shiprock plant). Because this gas is heavier than air, it is necessary to guard against leaks and to follow a safe procedure if a leak is discovered. When a leak does occur, the gas does not disperse readily but will settle in a pocket or a low point of ground or building, constituting a hazard.

Users of heavy-duty transportation equipment, such as trucks, shovels, carryalls, etc, find butane-propane gas an exceptionally good fuel. It insures instant starting, in all weather, without washing of cylinders as with gasoline and without fuel dilution of lubricating oil. An interesting special application of this gas is found in the truck field, where the expansion of the gas from the container is used to provide refrigeration for the pay load and the expanded gas, after passing through the refrigerating cycle, is used as fuel for the truck engine.

Another wide field of usefulness in which butane-propane is finding a place is that of industrial heating, particularly in portable burners such as plumber's furnaces, cutting torches, etc. Here freedom from burner-orifice clogging and the need for preheating, plus the convenience of containers that can be taken anywhere, form definite advantages.



ON SMALL-HP JOBS, THE COPPUS SMALL-HP STEAM TURBINE WILL SAVE YOU MONEY

You can get steam turbines in smaller frame sizes from Coppus than from most other makers whose smallest turbine is usually in a 100 H P frame. Coppus includes six sizes from 150 H P *down* to fractional.

Save money on initial investment (and save floor space, too) by selecting the proper size turbine from the Coppus line.

And when you see the blue band on the flange, you'll know you are getting a Coppus "Blue Ribbon" value — precision workmanship throughout. That's why so many manufacturers of pumps, blowers, stokers, mixers, etc., prefer to equip their products with the turbine that wears the blue ribbon.

Bulletin 135-9 will give you full facts. Check the coupon.

COPPUS

"WE GET BOILER EFFICIENCY OF AROUND 80% DAY AFTER DAY"

"Am very much pleased with their operation," writes this power company Chief Engineer about his Coppus-Dennis Fanmix Burners. "Operating an entirely automatic 400 H P boiler, and using natural gas, we get boiler efficiency of around 80% day after day. These burners pick up sudden load very nicely with perfect combustion."

COPPUS

Check the coupon to request Bulletin 410-3 describing further advantages of this "Blue Ribbon" product.

COPPUS BLUE RIBBON PRODUCTS

DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU

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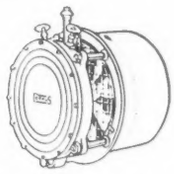
Sales Offices in THOMAS' REGISTER. See SWEET'S for other "Blue Ribbon" Products.

You'll get valuable ideas from these free bulletins on other Coppus Blue Ribbon Products

(Check the ones you want)



☐ Coppus Type C Turbo Blower. For undergrate draft. Bulletin 145-6.

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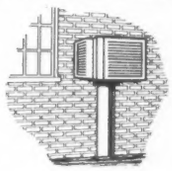

☐ Coppus Air Filters. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.

☐ Coppus-Dennis Fanmix Gas Burner (described in this ad).

☐ Coppus Steam Turbine (described in this ad).

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POWER LINES

Possible Shortage Looms; Utilities and Industrials Urged to Store Coal

Urging all utilities and industrial plants to store coal at once to the limit of their facilities, the United States Department of the Interior and executives of the National Coal Association agree that transportation and other difficulties may impede the delivery of steam coal a few months hence, if protective steps are not taken immediately.

Coal storage is urged not merely to insure continuous operation of the plants concerned, but also as a patriotic duty, because every increase in coal buying now will ease the expected heavy demand on railroad facilities this spring and summer.

The situation was outlined in a January news release by the Secretary of the Interior, Harold L Ickes, to whom President Roosevelt has assigned the job of coordinating solid fuels to make certain that supplies will meet war demands. POWER's editor also talked with Howard Gray, Solid Fuel Coordinator in the Department of the Interior and with J D Battle, executive secretary of the National Coal Association, both of whom agreed that the situation is serious and calls for immediate protective action by the utilities and the manufacturing industries.

Statement of Secretary Ickes

Secretary Ickes warned industries that depend upon coal and coke to take advantage of the surplus mine and transportation capacity, which will be available for a short while longer, to build up their stock piles to the limit, and then do everything they can to keep them there. Coal in storage, during times like these, he said, is the best possible protection against shortages. Such a move would lessen the possibility that consumers will have to appeal to the Government for help in obtaining fuel after the going gets tough.

The Secretary indicated that the greatly expanded war program will heap new and unpredictable burdens upon all solid fuels. Shortages may be expected in machinery, electrical and other mining equipment, tires for trucks and other supplies vital to the production and transportation of solid fuels. In addition, transportation, which is a vital factor in fueling the nation, will be affected by the new war program. The result all of this will have on the fuel supply cannot be foretold at this time.

From now until April 1, when the Great Lakes navigation season opens, the mines and transportation facilities will have a surplus capacity which consumers can utilize to pile up coal to safeguard them against trouble later. But in April, he said, the mines and transportation facilities will begin their annual drive to stock the Great Lake docks which supply the Lake states and part of Canada the year around. That, with the gathering momentum of the war program, will tighten the coal-supply situation considerably. Consumers should act for their own protection before that time, he concluded.

Discussing the fuel situation in a statement to the readers of POWER, J D Battle, Executive Secretary of the National Coal Association, said:

"Every coal producer should make a personal appeal to his customers to take their coal whenever the producer can supply it, the object being to level out production and prevent car shortages or other troubles that are looming up ahead of us. We must proceed on the assumption that the war will continue for several years.

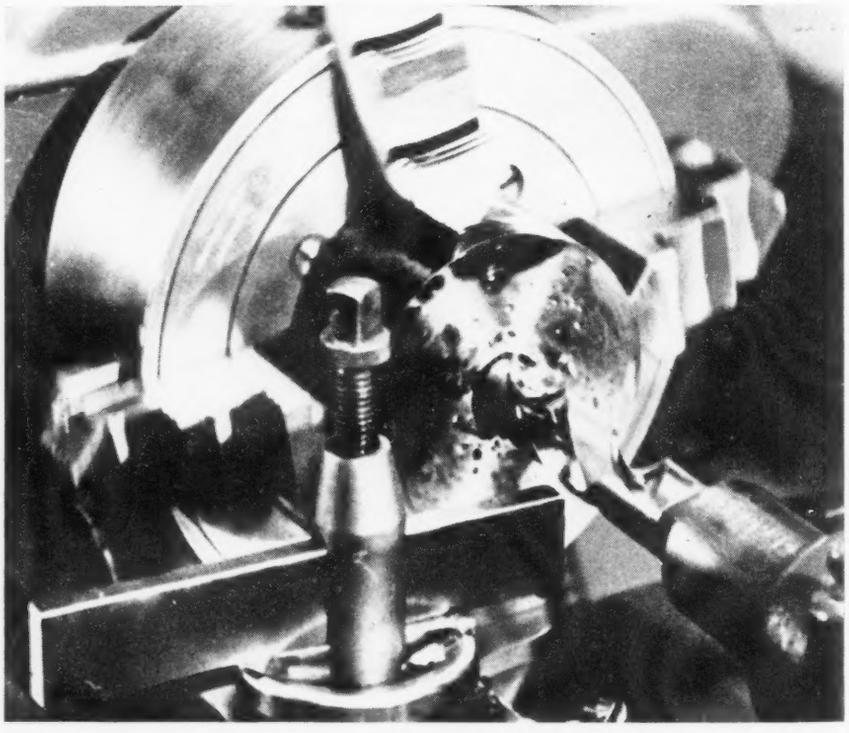
"Today our capacity and facilities for producing coal are not being used to their full extent. This is also true of railroad facilities. But this condition will not prevail for any great length of time. Full advantage should be taken of the lull before defense requirements of other industries press down upon all of us.

"The railroads are now called on to

What Can I Do?

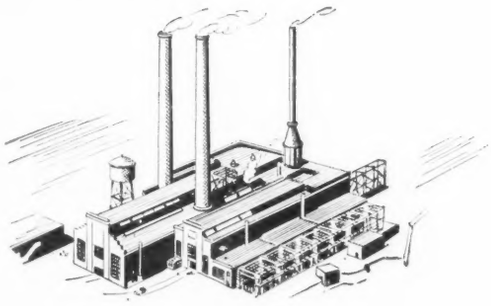
Reprints of the editorial published in January POWER, entitled, "What Can I Do?" by James H. McGraw, Jr, are available, should any readers desire to have them. Individual copies and small quantities are obtainable free, while larger quantities will be supplied at actual cost. Address requests to the Editor, POWER, 330 W 42nd St, New York, N. Y.

MOVIES FOR DEFENSE



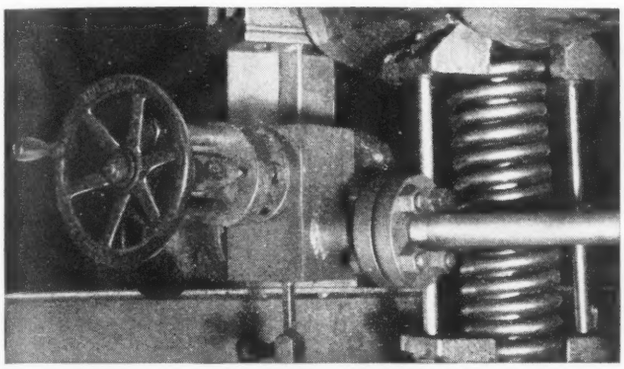
Showing the use of the engine lathe, this picture is taken from one of the sound films produced by the United States Office of Education, Federal Security Agency, to help train defense workers. The reel from which this picture is taken is one of a series of five on the subject of the engine lathe. This particular photograph is from the reel, "Drilling, Boring and Reaming Work Held in Chuck." The films are being distributed by Castle Films, Inc

For Long, Trouble-Free Life Under Severe Conditions

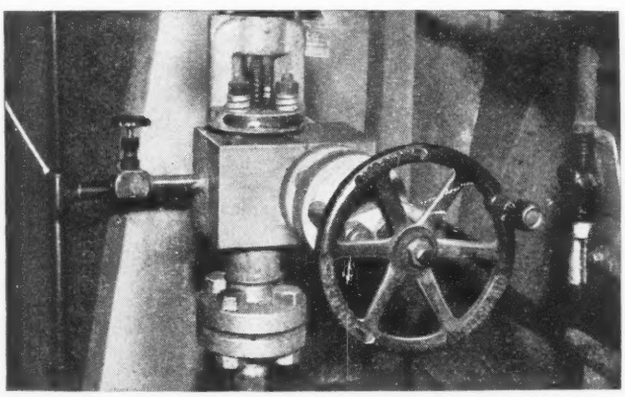


Mahoningside Station, The Ohio Public Service Co., Warren, Ohio, uses Haynes Stellite alloy on the seating surfaces of high-pressure, high-temperature valves.

Specify Valves with HAYNES STELLITE ALLOY Seating Surfaces



This blow down valve with Haynes Stellite alloy seating surfaces has operated at Mahoningside Station at a pressure of 830 lb. per sq. in., and a temperature of 525 deg. F., for over 3 years—and still operates efficiently.



Another valve, for handling steam at the same temperature and pressure at Mahoningside Station—still in perfect condition after 3 years of trouble-free service.

VALVES with Haynes Stellite alloy seating surfaces stand up almost unbelievably long even under the most severe conditions of pressures and temperatures. They assure longer life—reduce leakage losses—require practically no inspection or maintenance for years at a stretch. Because this reduces shutdown time and assures substantial savings, progressive power stations are specifying valves with Haynes Stellite alloy seating surfaces for high-pressure, high-temperature steam and feedwater service.

Haynes Stellite alloy is the ideal material to protect valve seating surfaces because:

- It is hard and abrasion-resistant, even at red heat.
- It takes a high polish and has a low coefficient of friction.
- It resists scoring, galling, seizing, and wire-drawing.
- It will not corrode or pit.

These are the reasons why so many power stations are using valves with Haynes Stellite alloy seating surfaces where pressures and temperatures are high. Valves protected by Haynes Stellite alloy are available from most valve manufacturers.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

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New York, N. Y. Kokomo, Indiana

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HAYNES STELLITE TRADE MARK

Red-hard, wear-resisting alloy of cobalt, chromium, and tungsten.

"Haynes Stellite" is a registered trade-mark of Haynes Stellite Company

handle an unprecedented tonnage to and from the West Coast because of the ship shortage, and this requires a great amount of locomotive power. It is possible that it may affect coal movement in the East a little later.

"We may expect defense industries to be given preference in coal and transportation. We may expect our labor supply at the mines to be curtailed by the draft. We are already losing some skilled workers.

"We may expect a curtailment in the movement of coal trucks as a result of weather conditions and the inability of truck owners to man and maintain them.

"We look for a production in 1942 of from 550 to 560 million tons of bituminous coal. We all know that unless it is moved regularly and full advantage taken of the present situation, difficulties will arise. The mining industries are having difficulty in getting equipment and supplies to keep going.

"We all know that should the Government once start allocating or parceling coal out to consumers, nothing but confusion will result. All of this governmental red tape as respects coal can be avoided if those who use coal will place their orders now for all that they can accommodate.

"All authorities say we are in for a long hard fight. Let's keep coal rolling, and in this way do our bit to keep the wheels of industry moving and win the war. Buy coal at once to the limit of storage capacity."

RECALLED TO SERVICE

The Niagara Falls Power Company currently is turning out power at Niagara Falls at a record rate and the long-idle Adams plant, recently returned to service, is operating at capacity. The company recently received official notification to divert another 7500 cu ft of water a second from Niagara River and has put into operation all facilities at the Adams plant.

The additional 30,000 kw of electricity "will go to defense industries when OPM allocations are completed, but temporarily are being absorbed throughout the Niagara Hudson system," a company spokesman said.

Until the allocations are completed, the system will "cut down 30,000 kw in its steam-generating plants," the spokesman declared

E G Grace Awarded Bessemer Gold Medal

E G Grace, president of Bethlehem Steel Co, has been awarded the Bessemer Gold Medal for 1942 by the British Iron and Steel Institute in recognition of his achievements in "fostering collaboration between the steel industries of two leading nations in a great world crisis."

Founded in 1874, in honor of Sir Henry Bessemer, the Bessemer Gold Medal has become the most highly prized international award for achievement in the steel industry. In its 45 years, the Medal has been awarded previously to only three other Americans—Andrew Carnegie, Charles M Schwab, and Albert Sauveur, who was the first American metallurgist.

Mr Grace was notified of the award in Washington by Ian Elliot, member of the Council of the British Iron and Steel Institute, acting upon cabled advices from John Craig, President of the Institute in London.

Prepare To Lose Men

A message to the readers of POWER *from Brig Gen Lewis B Hershey, Director of Selective Service*

"Most of the actual combat fighting in this war will be done by the young men of America. Modern warfare is of such a nature that it requires the greatest in physical stamina, coordination, and reflex action. Generally speaking, the fitness of men for modern combat service is in inverse ratio to their age.

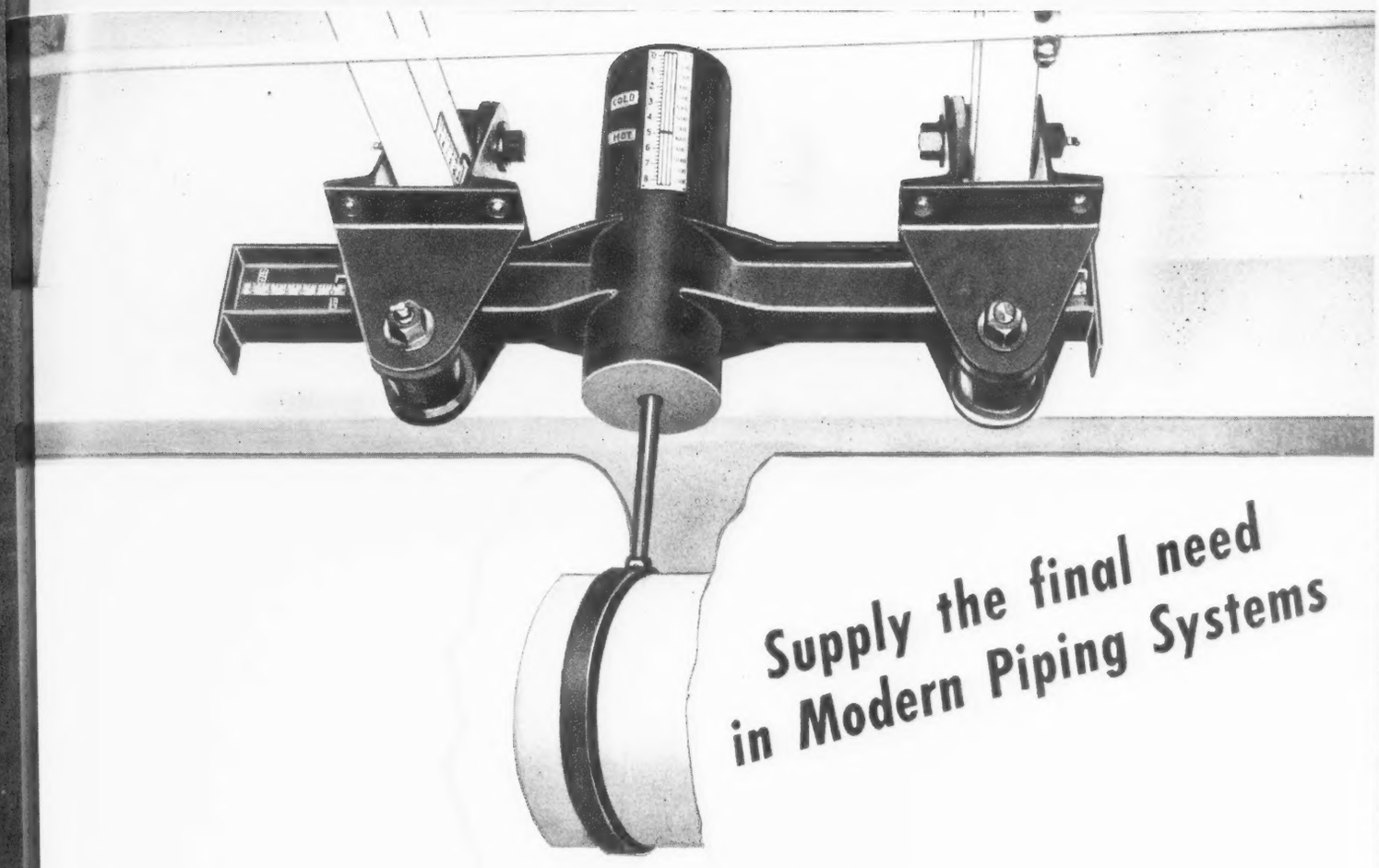
"Under recent legislation, more than 26 million men between the ages of 20 to 44, inclusive, are liable for military service. There are an additional 13 million men 18 and 19 years of age, and 45 to 65 years of age, who are to be registered. This gives America a total manpower of some 41 millions of men who must do the tasks that are necessary in total war for total victory.

"Selective service in total war is not going to deviate from the fundamental principles which governed its operations during the peacetime training program. Men will continue to be deferred from military service when they have dependents. Men will continue to be deferred from military service when they are 'necessary men,' and are difficult or impossible to replace.

"However, management and industry must recognize that the man who is deferred as a necessary man is deferred temporarily and each employer has the responsibility to secure and train replacements for such deferred men who are physically fit and would otherwise be available for military service. Occupational deferments are usually for a 6-month period. When absolutely necessary such deferment may be continued for additional 6-month periods, but only where their continuance in the present job is absolutely necessary for the maintenance of our national health, safety, and interest.

"There is an adequate supply of replacements for necessary men among those who are physically unfit for military service, those who are presently

(*Continued on page* 170)



Supply the final need in Modern Piping Systems

For improvement and simplification of modern piping systems we recommend the use of FLEX-ANAL CHARTS and Power Piping Functional Hangers.

FLEX-ANAL CHARTS are contained in a technical book entitled Design of Piping for Flexibility, published by Blaw-Knox Company – Power Piping Division, expressly for the use of piping engineers. These charts aid in figuring stresses in high pressure-high temperature piping by means of graphs and highly simplified formulae. FLEX-ANAL CHARTS provide a means of readily determining the magnitude and direction of movements in Piping Systems.*

Power Piping Functional Hangers and vibration eliminators provide for movements of any magnitude and direction within the piping system and eliminate vibration.**

* A copy of "FLEX-ANAL CHARTS" TO ANY ENGINEER ASKING FOR IT ON HIS BUSINESS LETTERHEAD.

**Send for Bulletin entitled POWER PIPING FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS.

BLAW-KNOX COMPANY

1525 Pennsylvania Ave., Pittsburgh, Pa.

FROM GOOD VALVE DESIGN

When Time Counts...as Well as Money

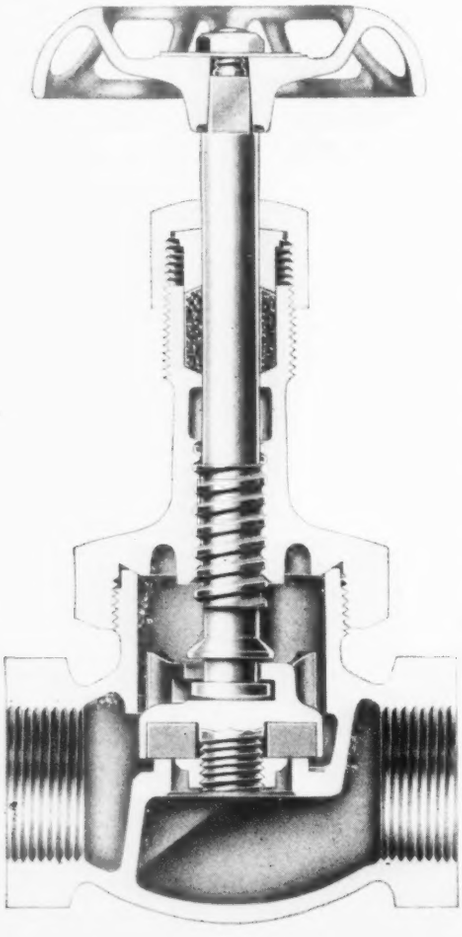
SPECIFY

JENKINS 106-A VALVES

NOW THAT TIME is more valuable than ever before . . . don't risk a costly shut-down when a valve disc must be replaced.

Install Jenkins 106-A Valves! On this famous valve it is actually only a matter of minutes to unscrew and lift out the trimming, slip on a new disc in its holder, replace bonnet . . . and the valve is drop-tight again!

Replacement of other parts is equally simple and fast. Precision manufacturing assures that any new part will fit exactly. In fact, you get such perfect interchangeability that four bodies and a handful of parts can be interchanged to assemble 26 different valves in the Fig. 106-A family!



No Valve Can Be Renewed Faster!
No Valve Gives You Finer Features!

PERFECT-GRIP HANDWHEEL – assures firm grip even with greasy hands. Jenkins non-heat design, constructed to prevent hand-contact with hot wheel-nut.

EXTRA-DEEP PACKING BOX – gives extra insurance against leakage, requires fewer packings. Packing is high pressure asbestos material, lubricated and graphited.

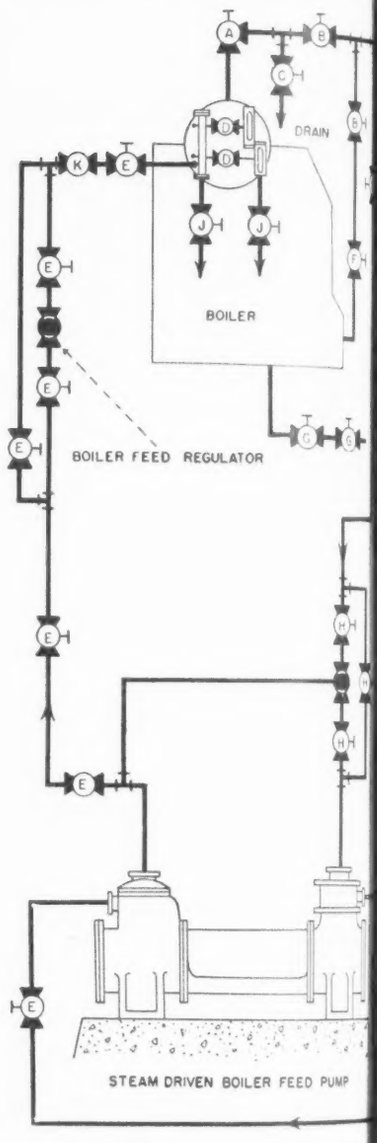
MORE SPINDLE THREADS IN CONTACT WITH BONNET – perfectly machined threads, and more of them in contact with the bonnet in both open and closed positions. You get more service and less wear.

ONE-PIECE SCREW-OVER BONNET – husky one-piece construction means more-times-off-and-on without springing body. Note beveled contact with body; an internal brace that adds 50% to strength of joint.

SLIP-ON STAY-ON DISC HOLDER – original with Jenkins, you simply open the spindle a turn or two and remove the bonnet without dropping the disc holder. Turn opposite and the holder slides off.

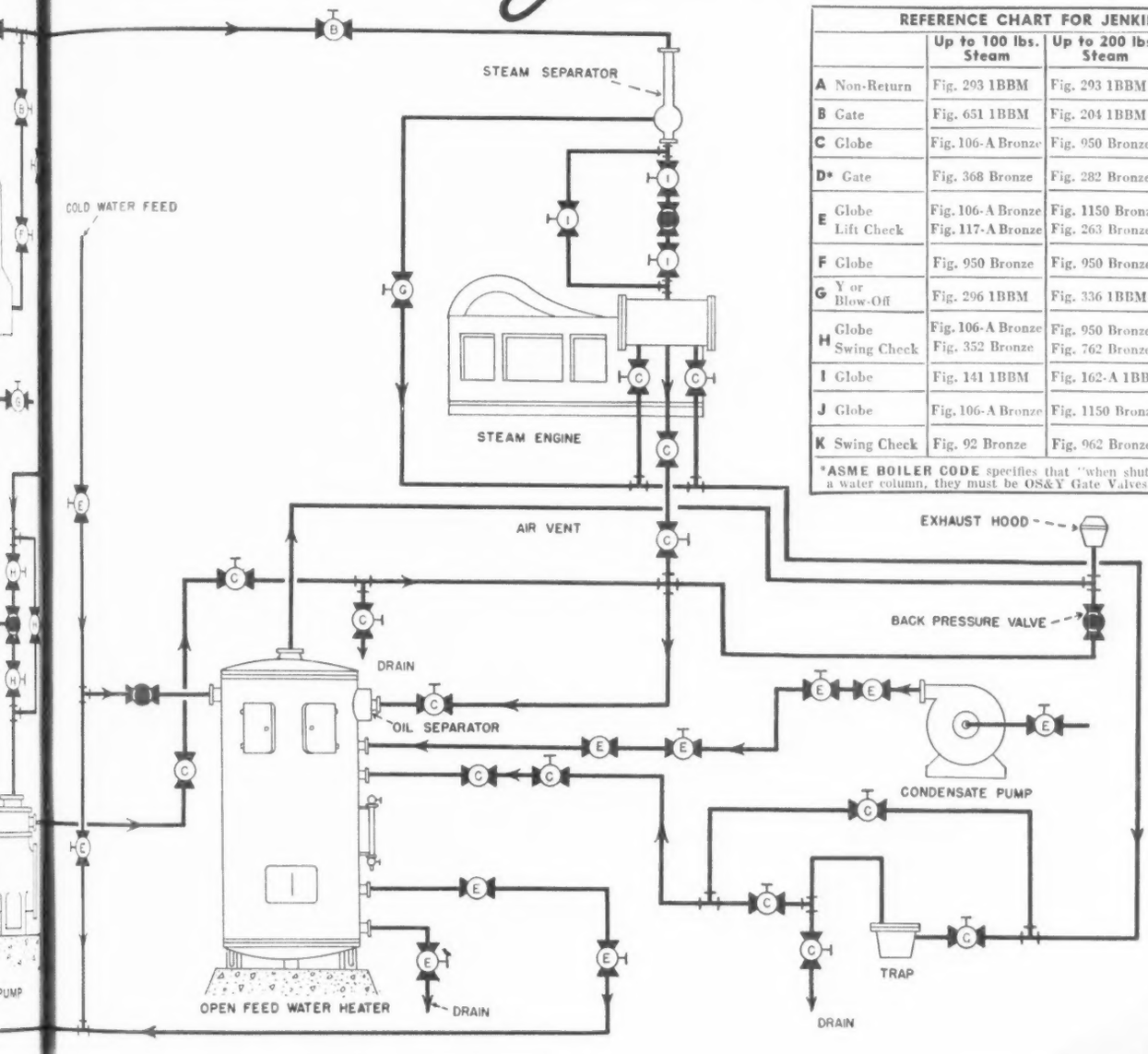
RENEWABLE COMPOSITION DISCS – Discs made by Jenkins are available for a wide variety of services including saturated steam, hot and cold water, air, gas, gasoline, oils, acids, alkalies, alcoholic beverages, liquid foodstuffs, as well as to meet U. S. Federal, Army, Navy and other specifications.

FOR ENGIN



JENKINS VALVES for every need

N CONNECTIONS *Jenkins* RECOMMENDS



REFERENCE CHART FOR JENKINS FIGURE NUMBERS				
	Up to 100 lbs. Steam	Up to 200 lbs. Steam	Up to 240 lbs. Steam	
A Non-Return	Fig. 293 1BBM	Fig. 293 1BBM	Fig. 293 1BBM	A Non-Return Valves
B Gate	Fig. 651 1BBM	Fig. 204 1BBM	Fig. 204 1BBM	B Header Valves
C Globe	Fig. 106-A Bronze	Fig. 950 Bronze	Fig. 1150 Bronze	C Drain Valves
D* Gate	Fig. 368 Bronze	Fig. 282 Bronze	Fig. 282 Bronze	D Water Column Valves
E Globe Lift Check	Fig. 106-A Bronze Fig. 117-A Bronze	Fig. 1150 Bronze Fig. 263 Bronze	Fig. 970 Bronze Fig. 263 Bronze	E Boiler Feed Valves
F Globe	Fig. 950 Bronze	Fig. 950 Bronze	Fig. 970 Bronze	F Soot Blower Valves
G Y or Blow-Off	Fig. 296 1BBM	Fig. 336 1BBM	Fig. 282 (Gate) Bronze	G Blow-Off Valves
H Globe Swing Check	Fig. 106-A Bronze Fig. 352 Bronze	Fig. 950 Bronze Fig. 762 Bronze	Fig. 970 Bronze Fig. 962 Bronze	H Auxiliary Equip. Valves
I Globe	Fig. 141 1BBM	Fig. 162-A 1BBM	Fig. 162-A 1BBM	I Engine Valves
J Globe	Fig. 106-A Bronze	Fig. 1150 Bronze	Fig. 970 Bronze	J Water Column Drain Valves
K Swing Check	Fig. 92 Bronze	Fig. 962 Bronze	Fig. 962 Bronze	K Boiler Feed Check Valves

*ASME BOILER CODE specifies that "when shut-off Valves are used on connection to a water column, they must be OS&Y Gate Valves and must be locked or sealed open".

#39
OF A SERIES
designed to help in selecting
JENKINS VALVES

JENKINS Bronze, Iron, Steel Valves to meet every need

A glance through the Jenkins Catalog shows that you can specify "Jenkins" for practically every phase of commercial, industrial, engineering and plumbing and heating needs. The line of over 600 valves includes:

Iron, Bronze, Cast Steel and Corrosion-resisting-alloy Gate, Globe, Angle, Cross, Y and Check valves... with composition, bronze, nickel alloy, iron and steel disc or plug... in solid wedge, split wedge, double disc-parallel seat and double disc-taper seat types... in inside screw and OS&Y patterns... with non-rising, traveling, rising and sliding spindle... conventional, quick-opening and rapid action... with screw-in, screw-over, union and bolted bonnet... with screw, flanged, union and solder ends... to meet Underwriters', AWWA, ASME and Marine specifications... in sizes ⅛" to 36"... for pressures from 125 to 600 pounds... for steam, air, oil, water, gas, chemicals, solvents and other fluids.

All are made to the standard of quality which has given Jenkins Valves the reputation of being "cheaper in the long run". Yet, with two exceptions, they cost no more to buy than other good valves.

AVAILABLE THROUGH GOOD SUPPLY HOUSES EVERYWHERE

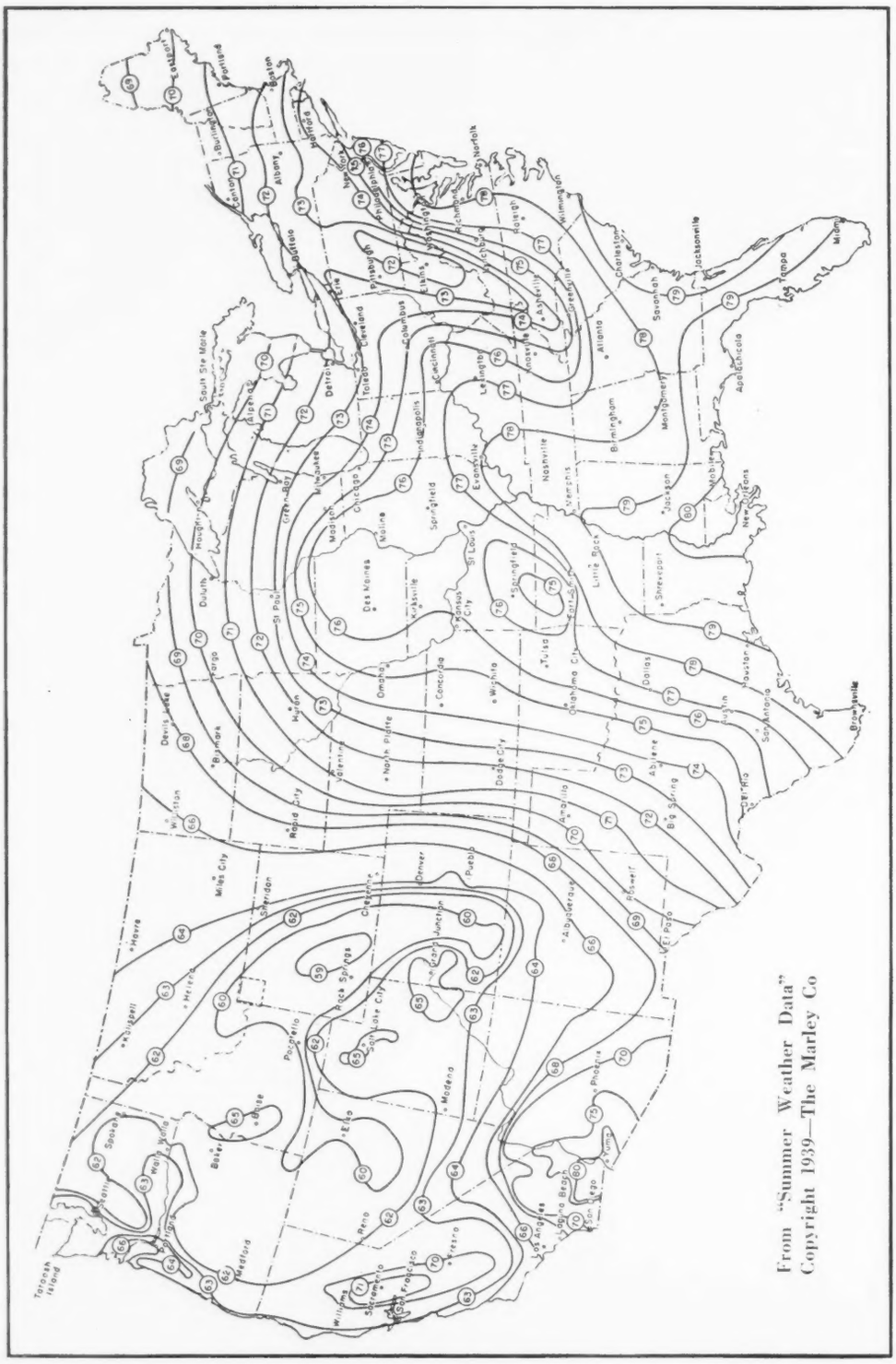
JENKINS BROS., 80 White St., New York, N. Y.; Bridgeport, Boston, Atlanta, Philadelphia, Chicago, Houston. Jenkins Bros., Limited, Montreal, Canada; London, England.

REG. U.S. PAT. OFF. TRADE JENKINS MARK
Jenkins Bros.

d Built Better for LOWER COST SERVICE

Number 114

Summer Wet-Bulb Temperatures



From "Summer Weather Data"
Copyright 1939—The Marley Co

FOR DESIGN OF COOLING TOWERS as well as air conditioning systems, wet-bulb temperatures influence equipment size. The values which are shown on this chart will be exceeded not more than five percent of the total hours during the period from June to September inclusive.

To meet the seasonal range, it is necessary that the equipment chosen be capable of operating with proper efficiency at the various daily loads. The daily temperature range and speed with which changes take place call for installing controls and equipment to permit following the daily variations.

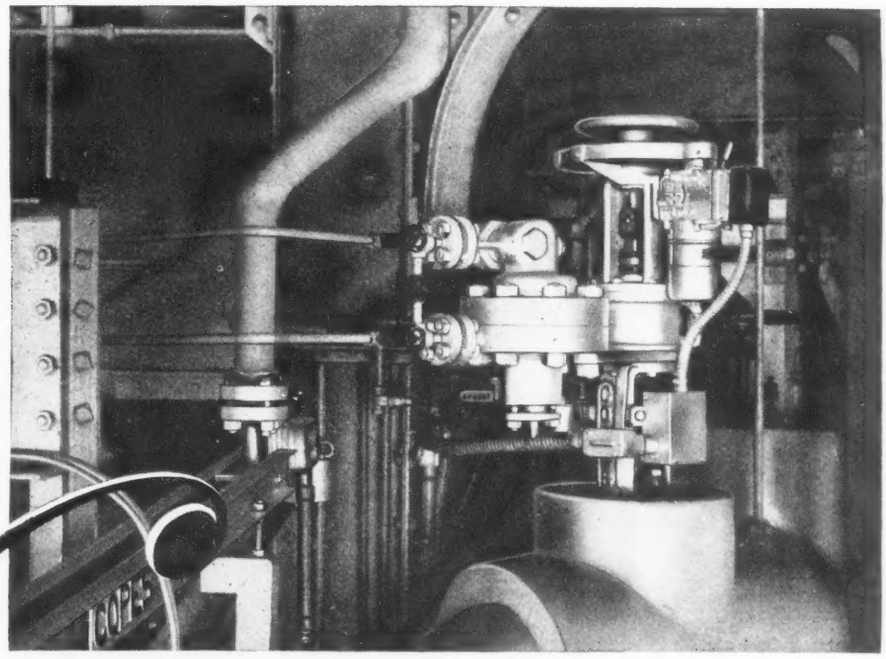
Map from "Summer Weather Data." Published by The Marley Co. Copyright 1939.

© POWER

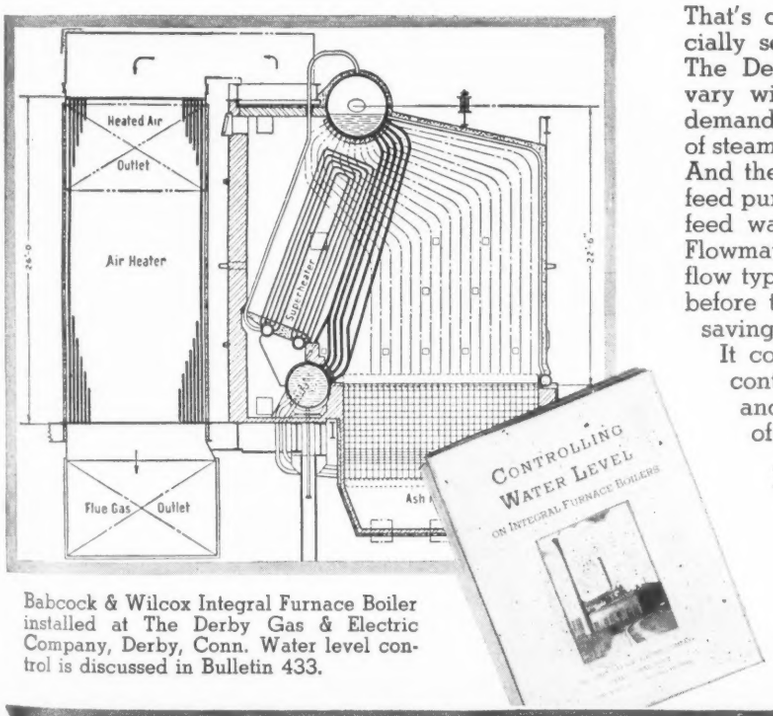
At The

DERBY GAS AND ELECTRIC COMPANY

Two 675-lb. 750-deg. B & W Integral Furnace Boilers with constant fluctuations in demands from industrial plants for power and steam at boiler pressure. Designed for 125,000 lb. an hr., with peaks of 150,000 lb. an hr. Fired with oil (normal) or powdered coal. Make-up about 25%. Gibbs & Hill, Inc., consultants.



COPES FLOWMATIC HOLDS WATER LEVEL ±1 INCH . . . .



Babcock & Wilcox Integral Furnace Boiler installed at The Derby Gas & Electric Company, Derby, Conn. Water level control is discussed in Bulletin 433.

That's close control on any boiler—and especially so on the two integral furnace units at The Derby Gas & Electric Company. Loads vary widely because of fluctuating industrial demands. Make-up is about 25 percent because of steam sold at boiler pressure to nearby plants. And there is no pressure control on the boiler feed pumps. Difficult conditions for an ordinary feed water regulator—but not for the COPES Flowmatic. This simplified two element steam-flow type regulator began to pay for itself even before the boilers were in regular service, by saving time in getting the new units on the line. It continues to return benefits by accurate control with no more than routine inspection and care. Write for Bulletin 433—the story of this interesting installation.

NORTHERN EQUIPMENT COMPANY
221 Grove Drive, Erie, Pa.

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves, Desuperheaters

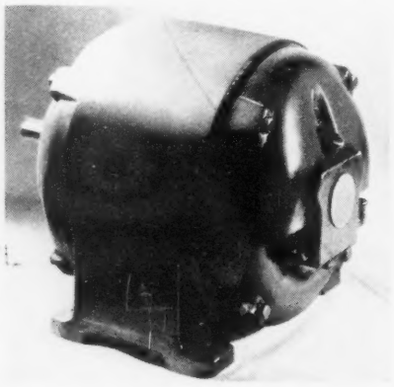
★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

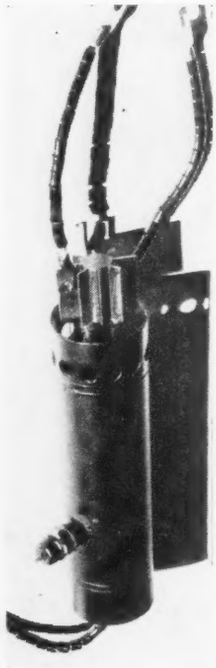
WHAT'S NEW IN PLANT EQUIPMENT

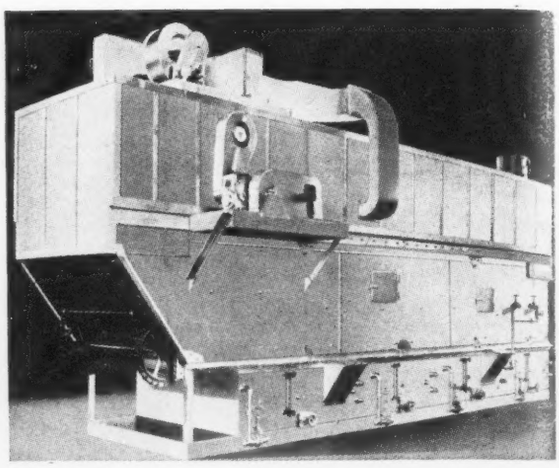
Motor

"SAFETY-CIRCLE" PROTECTED motor has wide solid rib integrally cast as part of motor, providing unbroken circle of protection around stator. One-piece cast frame and end shields guard motor from exterior knocks and abuses, while more liberal use of materials makes unit internally and electrically stronger



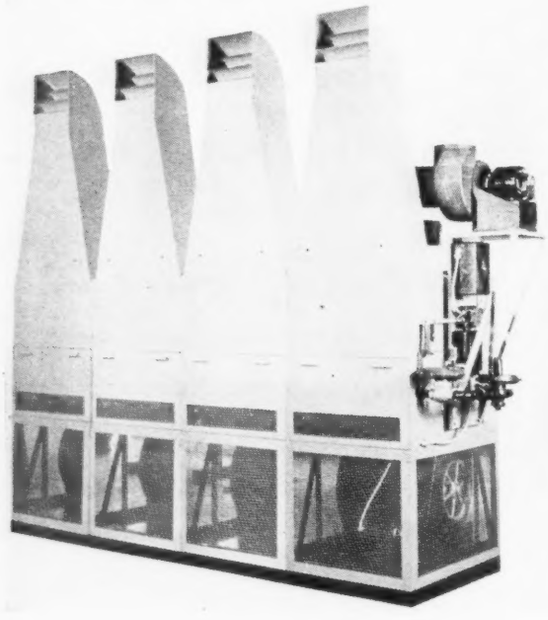
because current and magnetic densities are less extreme. Maker says additional cross strength is built into stator, rotor is keyed to shaft, and its outer surface is turned for smoothness and an accurate air gap. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*





Unit Heater (below, left)

HEAVY DUTY UNIT HEATER added to company line of Janitrol gas-fired space heating equipment. Unit is built up as series of sections, each having an input rating of 250,000 Btu per hr. Each section is complete, having its individual heat-exchanger assembly, pilot, limit control and blowers. Blowers of all sections are mounted on common shaft and driven by one motor. New heater incorporates "Multi-Thermex" heat exchanger and "Amplifire" burner, both company features on its equipment. *Surface Combustion Corp, Toledo, Ohio.*



Fuse Cutout (below)

PRIMARY FUSE CUTOUT is for use on ac circuits up to 12,500 volts, where fuse requirements do not exceed 50 amp. All contacts are silver coated to assure low contact drop, and fuse tube is made of moisture-resisting fibre-lined duck Micarta. Toggle mechanism provides drop-out action of door to indicate blown fuse. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Industrial Tube (above, left)

GL-414 THYRATRON IS an all-metal negative-grid tube for general-purpose industrial applications. Because it has a shield grid it is suitable for control circuits where available grid power is very small, and where it is desirable to actuate the grid from a high-impedance source. Typical applications include use on motor controls, welding controls, power rectifiers and voltage regulators. *General Electric Co, Schenectady, N. Y.*

Processing Machine (above, right)

DETREX PROCESSING MACHINE IS DESIGNED for cleaning and treating metal parts. Incorporates hot alkali wash, hot-water rinse, hot-chromic acid dip, hot-water rinse and oven dry off. Unit is fabricated from steel plate, reinforced with structural steel and is all welded, supported on a structural steel sill. Oven paneling is insulated with fibre glass. *Detroit Rex Products Co, 13005 Hillview Ave., Detroit, Mich.*

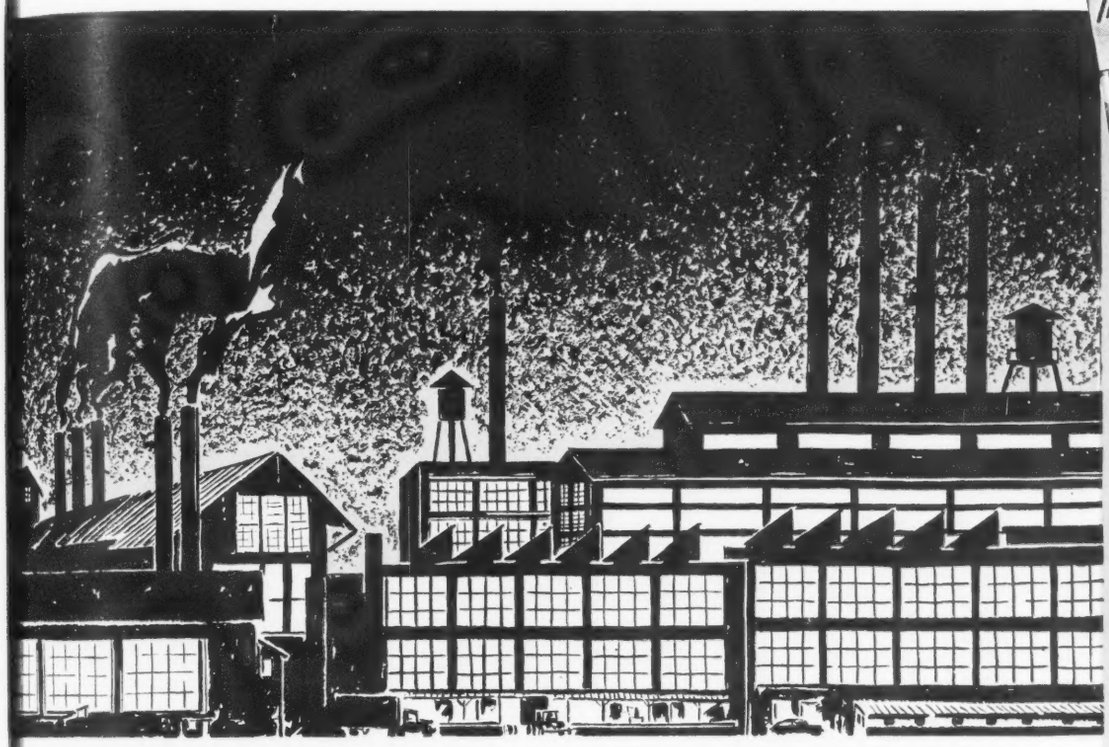
Drum Controller

NEW LINE OF DRUM CONTROLLERS for small cranes and hoists announced. Rope operating lever, using new equalizing-torque principle, eliminates cumbersome sheave wheel, rope guard and external return spring, providing

(*Continued on page* 134)

HOW TO KEEP PIPE LINES WORKING

...round the clock!



TIPS ON VALVE TRIM
TO HELP KEEP PIPING ON THE JOB
PLEASE CHECK AND PASS ON
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE
11 SIMPLE WAYS TO GET BETTER SERVICE FROM PIPING EQUIPMENT
HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!

These Bulletins Help Train Piping Crews; Aid in Getting Better Service From Valves and Fittings

VICTORY demands round the clock production! And while the burden will have its toll of plant equipment, industry's pipe lines—*its life lines*—must not fail in this task.

Keeping pipe lines working means getting better service from valves and fittings. That demands *more* and *better trained* men to keep up with and ahead of wear and tear. And that's where Crane Shop Bulletins are helping industry. These Bulletins, designed especially for maintenance workers, are chock-full of practical pointers on *everyday* installation and care of piping. They help train new men —improve the work of veterans as well.

The Bulletins are being widely used in maintenance shops and employee training schools. In the hands of your men, they will also help prevent piping trouble—*and keep production moving!*

Crane Shop Bulletins are offered to every plant—big and small—to help *speed* Victory. No charge—no obligation! For your supply, just call your local Crane Representative—or write to us.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Sore as—

American arm-chair analysts have always quoted the story of the Jap "human torpedoes" (who blew up themselves with the Chinese barbed wire) as an example of the fanaticism which is supposed to make Japs something extra dangerous as opponents. The recent attack on our South Sea islands again brought that and the *hara-kiri* stories to the fore in the newspapers.

It makes good copy—but it isn't true. Any boxer will tell you that the opponent who gets "blind-mad" in the ring is in for a drubbing. Even more to the point was the statement of Capt W W Stromberg about Colin P Kelly, who died bombing the *Haruna*. Capt Stromberg was president of Kelly's class at West Point in 1937. Said Stromberg recently for *The New Yorker:* "They talk about the Japanese suicide bombers. Why, a man like Kelly is a bigger threat to an enemy than any suicide bomber. Kelly, C P, didn't want to die. He wasn't hysterical or fanatic. He was serious about bombing; he was serious about hitting the target. He knew what a battleship is, what it is worth militarily. When he . . . sighted the *Haruna*, Kelly, C P, was—he was just in a position to do what all his years of work and training and reading and theorizing and practicing had taught him to do. He didn't think about his chances of getting shot down. He just figured out his chances of sinking the *Haruna*. He kept going until the margin for error had closed up scientifically to practically nothing and he knew he couldn't miss. He was a bomber pilot bombing a battleship, and he bombed it. When they shot him down doing it, he didn't feel exultant or martyred or any of those things. You can be sure of that. Kelly, C P, was sore, *sore as hell!*"

Sore as hell? He had a right to be! He had done everything he was trained to do—had completed his mission—and then was shot down when he was all set to go back for another load of bombs and do the same job over again. He was no "suicide bomber." He was a trained man busy at the work he knew best.

I think that he has set an example for us all to remember and profit by. Fanaticism is just another kind of madness, always inferior to training. The madman is an animal—at the eventual mercy of any reasoning man.

It is terribly important for us—as a nation and individually—to remember that fact. Hysteria and fanaticism, either on our side or the enemy's, never won a war.

They won't win this one either.

George Edwards

Engineer

Since the attack on Pearl Harbor, production in a West Coast aircraft plant has increased 25 per cent without any increase in facilities for production—except cold anger.—*The Sun*, (New York) Dec 24, 1941.

YOU WON'T NEED TO WORRY ABOUT PIPE FLANGES IF YOU SEAL 'EM WITH J-M SERVICE SHEET

Uniformity, dependability, high quality... these are the features that make J-M Service Sheet the No. I Sheet Packing for industry

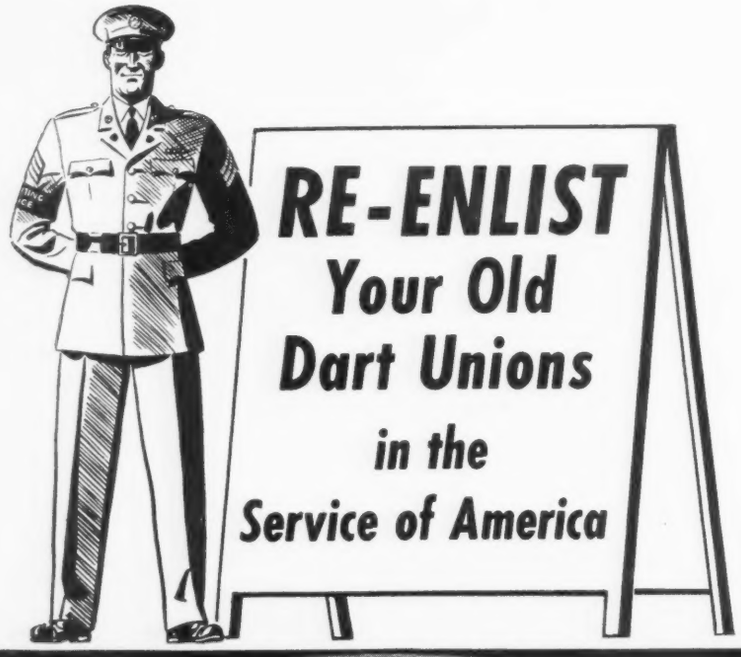
MORE AND MORE engineers are safeguarding gasket performance by switching to J-M Service Sheet. Basically asbestos, this tough material not only stands up longer, but is completely uniform, both in density and quality. Because it does not deteriorate with age, it can be kept in stock indefinitely.

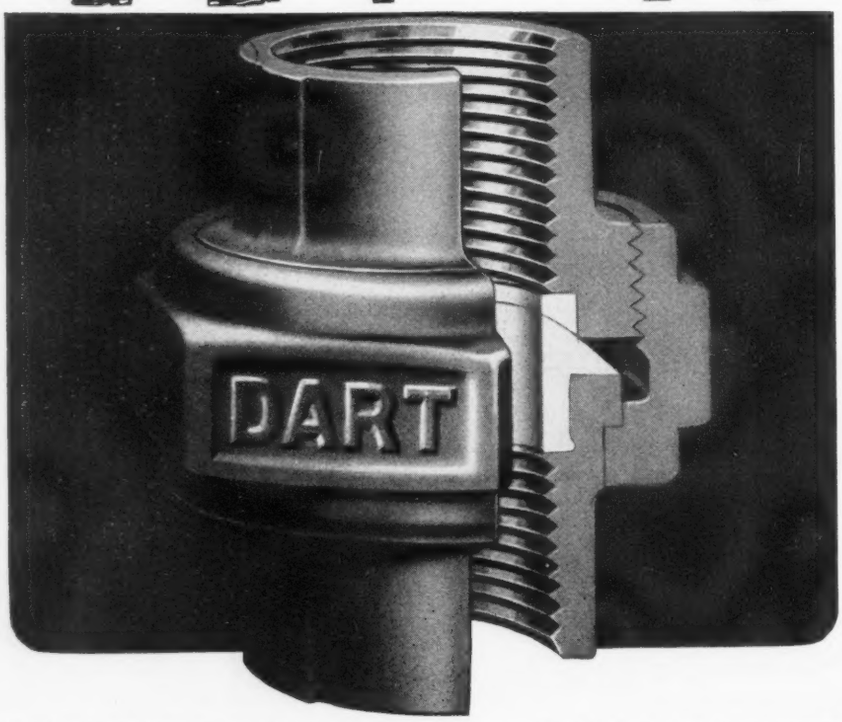
If you're not already using J-M Service Sheet, it will pay you to investigate. And if you have any other packing problems, you'll find an efficient, economical solution in the balance of the complete J-M line. For details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU





Here is a patriotic tip, in behalf of metal conservation: Dart Unions that have already given much efficient, trouble-free service and been "retired" or discarded, *are still capable of going back to active duty* . . . and of turning in a first-class performance. So, we suggest that a search be conducted throughout your plant to find and re-enlist your used Dart Unions in your particular Victory Effort.

There are excellent reasons why Dart Unions can be used so many times and give such complete satisfaction, such "first-time" tightness, every time. Here is one reason. Darts have matched bronze seats, ground to accurate "true-ball" surfaces. Here's *another*. Dart bodies and nuts are made of air refined malleable iron that resists pipe strains, rough handling, rust.

The manufacturers of Dart Unions are proud that old Darts as well as new ones are helping in this crisis. Remember—for *old* Darts search your plant and scrap piles of old pipe . . . for *new* Darts see your supplier today.

DART
UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

New Plant Equipment

(*Continued from page* 130)

smooth operation even when rope is pulled at an angle. New anti-plug feature increases drum life by making impossible to whip drum from full forward to full reverse position. Drum can be reversed quickly, but definite time lag is required in off position. *Cutler-Hammer, Inc, Milwaukee, Wis.*

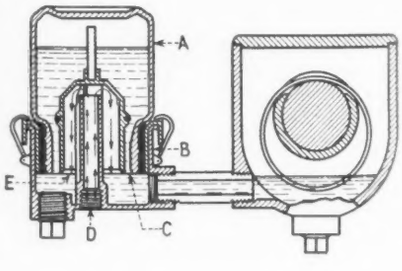
Stoker Timer

SYNCHRONOUS STOKER TIMER has removable timing mechanism and employs self-starting line-voltage synchronous motor. Standard models operate at 30 or 60-min. intervals, with "hold fire"

period adjustable from 1 to 11 minutes. To test fire, an external knob is turned until stoker starts. Special feature is built-in fused line disconnect switch, in which fuse can be changed without removing control cover. *Perfex Corp, 500 W Oklahoma Ave, Milwaukee, Wis.*

Constant-Level Lubricator

OIL-RITE CONSTANT-LEVEL LUBRICATOR is positive and automatic operating, said to remove human factor from lubrication. When reservoir *A* is filled with oil and inverted on its base *B*, only enough oil will be released to maintain the required level. When oil has been used in the bearings the liquid seal at the reservoir mouth *C*, and edge of dome *E*, is broken, and air is admitted, *D*, to the reservoir, forcing the oil down to re-



Cushioned Quietly

TO A DROP-TIGHT SEAT..

to prevent head-loss and line-damage

AIRFOIL DISC is the only moving part in a Chapman Non-Slam Check Valve... rides steadily in the flow, as shown above, when valve is open. Then as flow slows, this disc closes silently, without rubbing or wear. Slamming is impossible . . . head-loss is cut 65 to 80% . . . damage from hammering, surging and strained pipe-joints is prevented. This unique design, plus stout construction, means that Chapman Non-Slam Check Valves last indefinitely, without maintenance. Made in both iron and steel. 12-page book gives full operating and cost data. Write for your gratis copy *now*.

Chapman

NON-SLAM CHECK VALVES

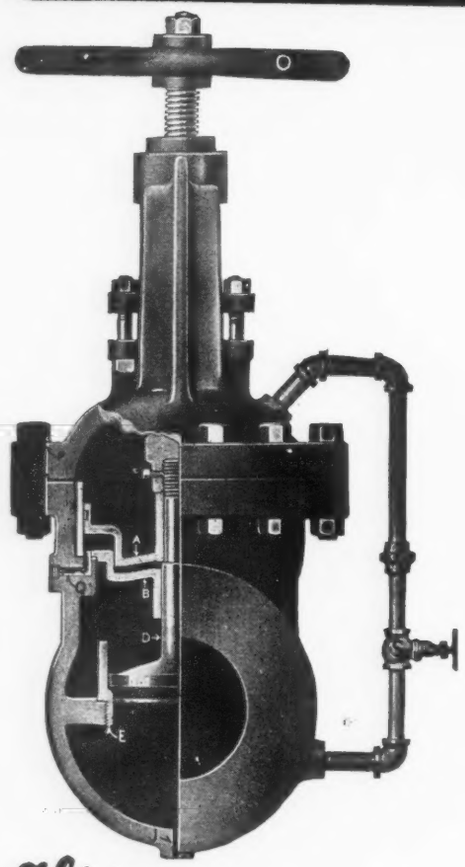
The CHAPMAN VALVE Mfg. Co., Indian Orchard, Mass.

★

Golden-Anderson

SPECIALTY

VALVES



THROTTLE AND EMERGENCY STOP

● With G-A's throttle and emergency stop valve, you're assured of protection against damage to valuable property, for it automatically shuts down any overspeeding engine or turbine. It works instantly . . . mechanically, electrically, or by hand . . . even to being tripped by a push button from remote points. No unit can exceed safe operation speed when equipped with this valve, as maximum speeds are rigidly controlled. Comes in angle and globe patterns from 2½" to 16" in size. You'll find these quality G-A valves in use, under every pressure, on all types of steam engines and turbines. For a more detailed description of the complete G-A line, write for our free catalog today.

Also

Triple Acting Non-Return . . .
Altitude Control . . .
Float Control . . .
Pressure Reducing . . .
Check Valves, etc.

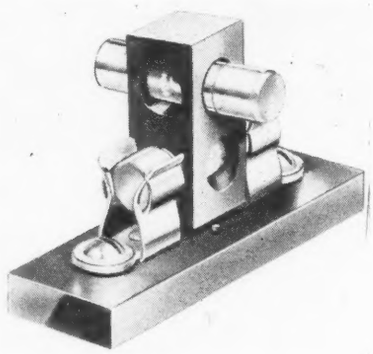
GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BUILDING • • • PITTSBURGH, PA.

quired level. A reserve supply in the reservoir will continue to maintain this level. An air filter may be attached to opening *D*. Plastic porcelain cement holds the glass reservoir to metal collar, and is impervious to acid, oils, water and heat. Felt wick on dome edge serves as a stopper when refilling. *Oil-Rite Corp, 332 West Wisconsin Ave, Milwaukee, Wis.*

Fuse Changer

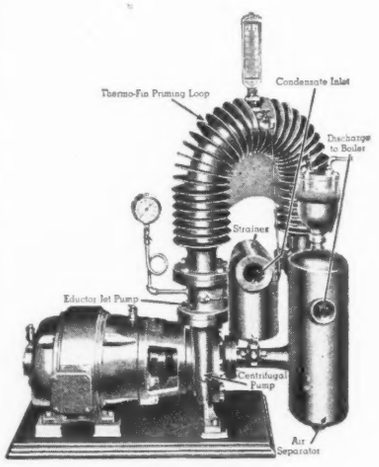
SPARE FUSE-HOLDER and puller combined, made for all normal applications. Fuse in circuit goes through one end of the soft rubber rectangular holder, between clips. Above, and at right angles, is an opening in the holder



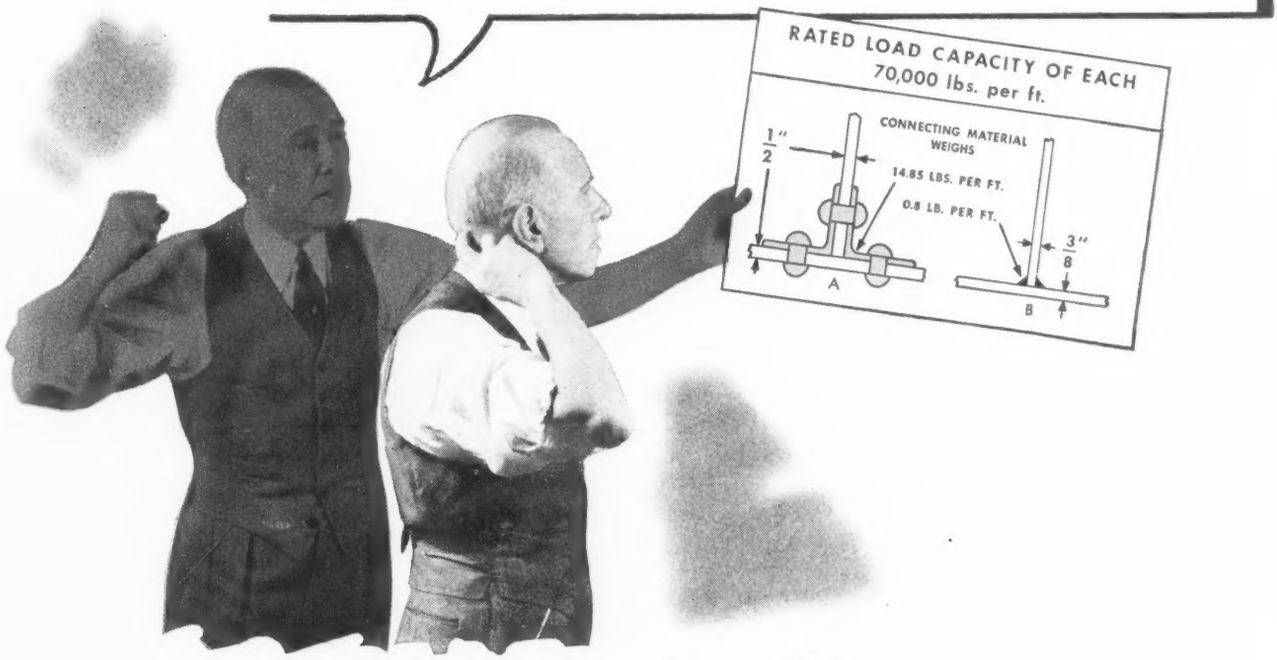
for spare fuse. When inserted, cap of spare fuse projects beyond holder, affording an easy grip for two fingers. When the fuse in the circuit blows, all operator has to do is to pull and reverse fuse-holder. This puts spare fuse into circuit and brings blown fuse on top. *Littelfuse, Inc, Chicago, Ill.*

Condensate-Return System

EDUCTOR PRINCIPLE OF OPERATION in return system insures thorough condensate and air removal from process apparatus. Then after expulsion of air from closed circuit, condensate is re-



then I said to myself—



This looks like . . .
MORE FOR LESS

We've been more or less successful in our methods—but let's assume we're wrong. Let's get a fresh start and prove each step as right before we take it.

ALTER EGO: Fine exercise to prevent manufacturing ruts. Let's start with the two ways of joining two plates at right angle, say. What's the procedure for method "A"?

It's plain to see we hold the plates with angles and rivets. We must drill or punch holes, fit them up, fill them up with rivets and hammer down the heads of the rivets. This requires 14.85 pounds of connecting material per foot of joint.

ALTER EGO: And in method "B" you just weld a bead along each side of the joint. This joint requires only 8/10 of a pound of connecting material per foot. But look closer, what else do you find?

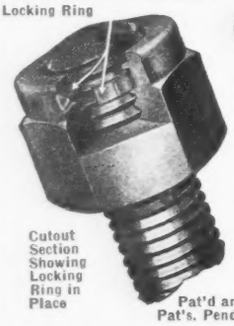
Here's the big point. To get a load capacity of 70,000 pounds per foot, in the case of "A" we must use ½-inch plate—while in "B" we can use only ⅜-inch plate!

ALTER EGO: Isn't it obvious then that welding gives MORE for LESS. Now, how can we get that for our present work and future plans?

A good starter would be to invest $1.50 in that Procedure Handbook which is published by The Lincoln Electric Company, Cleveland, Ohio, and study it so that we can figure out how arc welding can give us MORE for LESS.

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

Locking Ring



Cutout Section Showing Locking Ring in Place

Pat'd and Pat's. Pend.

Get a Grip on Savings!

True protection for all moving parts or reciprocating engines, pumps, generators, stokers, etc., "Unshako" is a simple, foolproof device you can depend on to G-R-I-P wherever vibration is the problem.

Saves maintenance time, reduces breakdown trouble!

For free samples and details, write—

UNSHAKO

Reg. U. S. Pat. Off.

SELF-LOCKING NUT

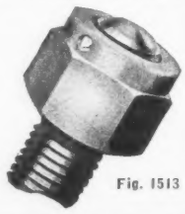


Fig. 1513

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA. Box 577

— Branches —

Boston • Detroit • Indianapolis • Chicago • St. Louis • San Francisco

Below, a reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.

I can see it from here

You can sit back and relax when you have installed PYREX Broad Red Line Gauge Glasses, because you can see the water level from one end of the boiler room to the other.

The transparent, broad red line fused directly to the wall of the gauge glass itself makes the water level stand out clearly and distinctly.

You can stop worrying about costs, too, for actual service records prove that PYREX brand Gauge Glasses last longer. Resistance to thermal shock protects them against sudden temperature changes. Machine drawn accuracy decreases installation strains. Transparency remains unimpaired by corrosive action of steam.

For serviceability with visibility, install PYREX Broad Red Line Gauge Glasses. Stocked by leading mill and steam supply dealers.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works.

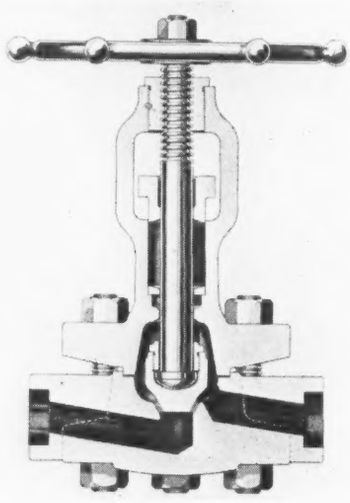
CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

turned to the boiler at temperatures close to that of process pressure without flash loss and with fuel saving. Specially designed centrifugal pumps draw water from thermo-fin priming loop and discharges it as a high-velocity jet through jet-pump nozzle. This jet striking returned hot condensate, induces condensate flow through mixing tube into thermo-fin priming loop. Additional volume of returned condensate introduced into constantly filled results in discharge of equal volume through air separator to the boiler. *Cochrane Corp, 17th and Allegheny Ave, Philadelphia, Pa.*

Integral Seat Valves

INTEX GLOBE VALVES are specifically designed for high-pressure and high-temperature service (pressures to 1500 lb at 950 F). Disk and integral seat faced with Stellite. Valves available in ½ to 2 in. sizes in socket welding, flanged or screwed ends. *Edward Valve & Mfg. Co, East Chicago, Ind.*



Strain Gage

RECENT DEVELOPMENT IS USED for detecting and indicating strains in industrial machinery. Comprising a rod, lever arm, and head, gage looks like the side view of an automobile jack. Rod is fastened at either end to the machine in the direction of the strain. Lever arm, attached at its outer end to the machine, is at right angles to the rod. Gage head consists of an armature operating within two coils. Before job is started, position of armature within coils is so adjusted that a zero reading is registered on a connecting instrument. When machine is put in operation and strain exerted, rod pulls down on lever arm. Arm in turn pulls down on a pin in the armature and moves armature to a new position

THE DANGER LIES AT THE TURNS

Accidents lurk when power and speed crowd *PIPING TURNS* too!

In 6-day bicycle races, if riders come to grief—it's usually on the turns where speed and strain increase the danger. (I.N.S. photo)

Weld piping with TUBE-TURN fittings to prevent trouble at the crucial spots!

It takes strength and stamina to withstand the grueling pressure of a 6-day bike race, but that's nothing to the strain and stress imposed on many piping lines. The greatest concentration of pressure in pipe lines is placed on the turns—*wherever there is a change of flow direction.* Tube-Turn fittings are engineered for added protection *where the danger lies*—wherever elbows, returns, tees, reducers, laterals, nipples and flanges are used. You will find a type, size and weight of Tube-Turn fitting for *every* pipe welding need. Look for the Tube-Turn insignia welded on each fitting.

Write for Tube-Turn engineering data book and catalog.

TUBE-TURNS
INCORPORATED
LOUISVILLE, KY.

Branch offices: New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

TUBE-TURN *Welding Fittings*
TRADE-MARK

HOW TUBE-TURN FITTINGS PROTECT WHERE FLOW DIRECTIONS CHANGE

This compact piping installation illustrates four common points that occasion *changes in flow direction*—a welding tee at the top, then a 90° elbow, a reducing outlet welding tee at the right, and a concentric reducer near the bottom. Tube-Turn welding fittings are used here to guard against danger at these turns.

"FRAHM" TACHOMETERS

A Tachometer that requires no maintenance

The "Frahm" Vibrating-Reed Tachometer does not even have to be oiled because it contains no gears, bearings, rotating or any other wearing parts,—nothing to maintain or even to wear out. There is no electrical system—merely a set of accurately tuned steel reeds which vibrate by resonance according to the speed at which the machine is running. Simply mount the Tachometer in almost any convenient location; the slight vibration in the machine when running does the rest.

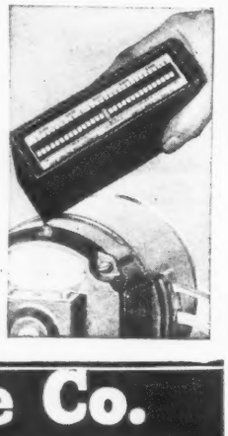
For more than 30 years we have supplied these unique speed indicating devices for use on turbines, generators, motors, centrifugal pumps and blowers. Ranges are available from as low as 900 up to 15,000 r.p.m.

More recently our hand type of "Frahm" Tachometer is being used for general speed-measuring work, and also for measuring rates of vibration, such as in pneumatic hammers and drills and in airplanes.

Write for illustrated descriptive Bulletin 1590-P.

CENTRIFUGAL TACHOMETERS

We now offer a Heavy Duty Hand Tachometer of the centrifugal, pointer-indicating type. Simple, rugged and reliable. Ask for Bulletin 1710-P.



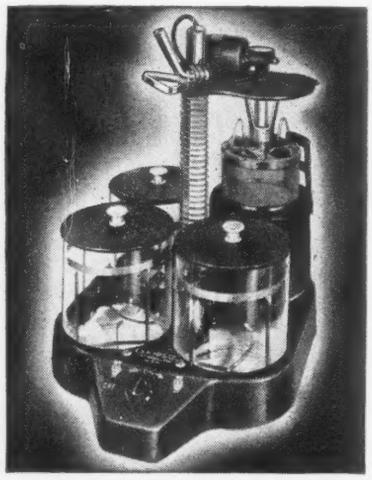
James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

within the coils. This affects the electromagnetic relationship between armature and coils in accordance with amount of strain exerted. Instrument, previously calibrated against known strain loads, then indicates extent of unknown strain. *General Electric Co, Schenectady, N. Y.*

Cleaning Machine

L & R CLEANING EQUIPMENT is for regular cleaning of delicate instrument parts. Disassembled parts of instrument are placed in work basket and loaded basket is snapped into position on motor shaft. Basket is first lowered to cleaning solution jar, where cleaner acts through agitation. Then basket is raised above level and rotated to remove excess

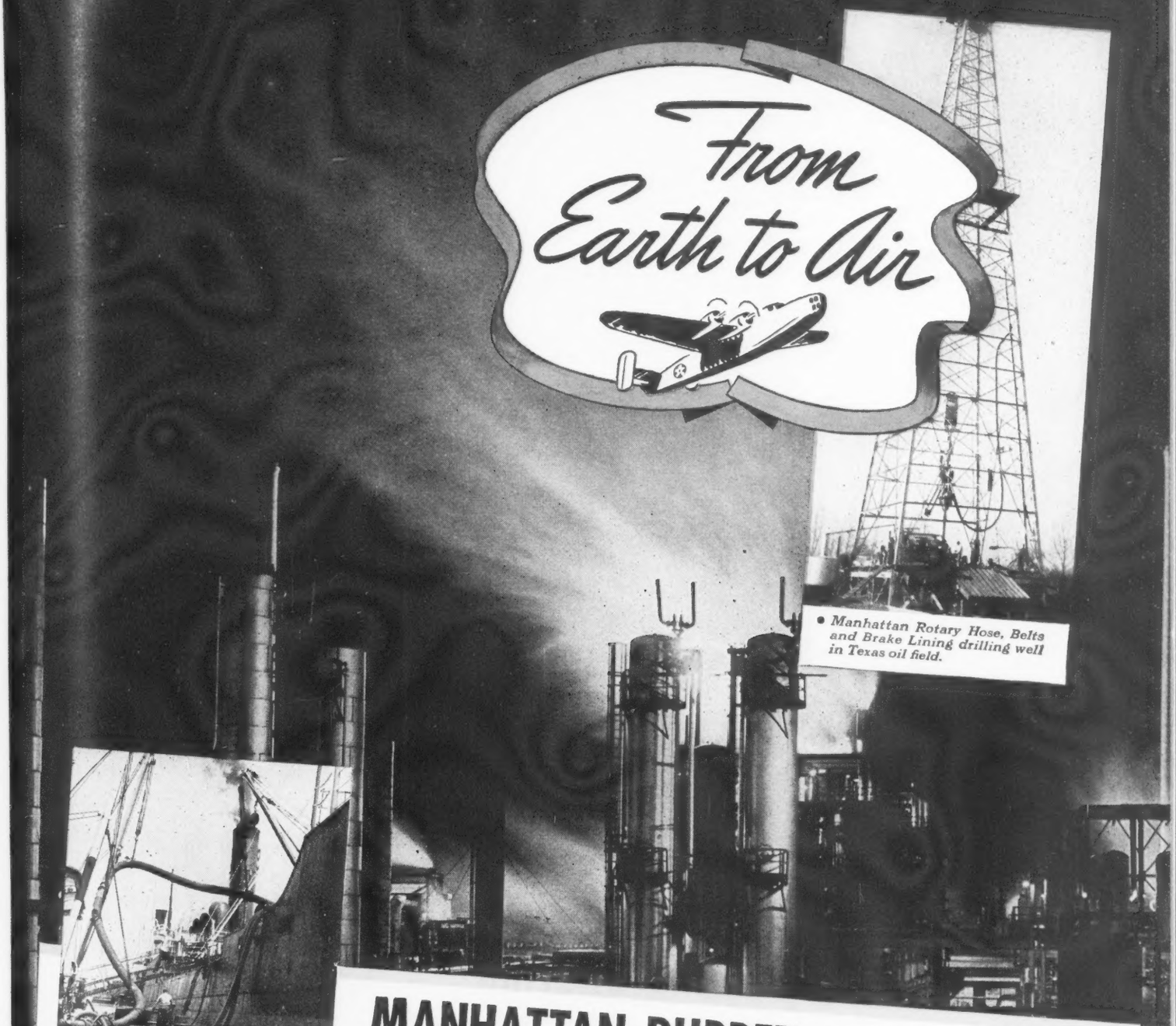


cleaner. Then following two operations are carried out in rinsing solutions. Motor carrier is then revolved to fourth position, which is over drying chamber. This contains a separate motor in combination with vitreous heater. About two or three minutes are required for each phase of cycle, depending on type of instruments cleaned and condition of parts. *L & R Mfg Co, 54-56 Clinton St, Newark, N. J.*

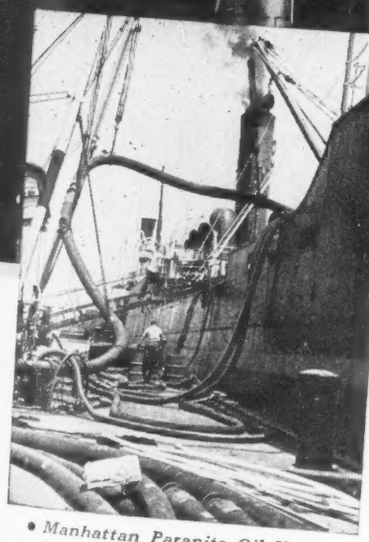
Insulation Test Set

DESIGNED FOR TESTING insulation of diesel electric locomotives and other railroad electric equipment, set includes as a unit high-voltage transformer, means of regulating test voltage, and necessary overload and over-current devices for complete protection. Voltage supply is received at the set through a breaker with thermal overload element for protecting the set. An instantaneous trip over-current relay is also provided to remove test voltage in case of test peak. Test voltage is regulated by a control knob operating variable voltage transformer to give smooth potential rise. Pushbutton control stations in the han-

From Earth to Air



• *Manhattan Rotary Hose, Belts and Brake Lining drilling well in Texas oil field.*



• *Manhattan Paranite Oil Hose loading tanker at Eastern Port.*

MANHATTAN RUBBER speeds the products of *Petroleum*

Deep into the earth sometimes to three pressure-ridden miles—go the drills that search for the pools of "liquid gold" needed for propulsion and lubrication—twin servants of Defense.

Drilling, pumping, refining, loading—all are functions in which MANHATTAN Rubber collaborates for increased production.

At the well, the use of MANHATTAN Rubber begins—Rotary Hose, Pump Suction Hose, Flat and V-Belts, Draw-Works Brake Lining, Rubber Covered Pistons, and many other necessary items—all of Rubber, but each compounded of natural rubber or Synthetic materials to fit specific requirements.

At the refinery, MANHATTAN speeds the output with special types of rubber hose for filling barrels, tank cars, tank trucks, tankers, and bunkers—and protects with fire hose.

In the air, MANHATTAN keeps them flying seven miles up in the sub-stratosphere with engineered rubber hose that withstands the extremes of intense engine heat and bitter cold—for fuel, oil, instruments and controls—and then stops them with brake lining.

Versatile Rubber, in many forms and combinations, records the long succession of MANHATTAN developments and applications to increase the output and the effective use of essential petroleum products. Some of the more vital uses were made possible by MANHATTAN'S being the first to adapt "synthetic rubber" commercially.

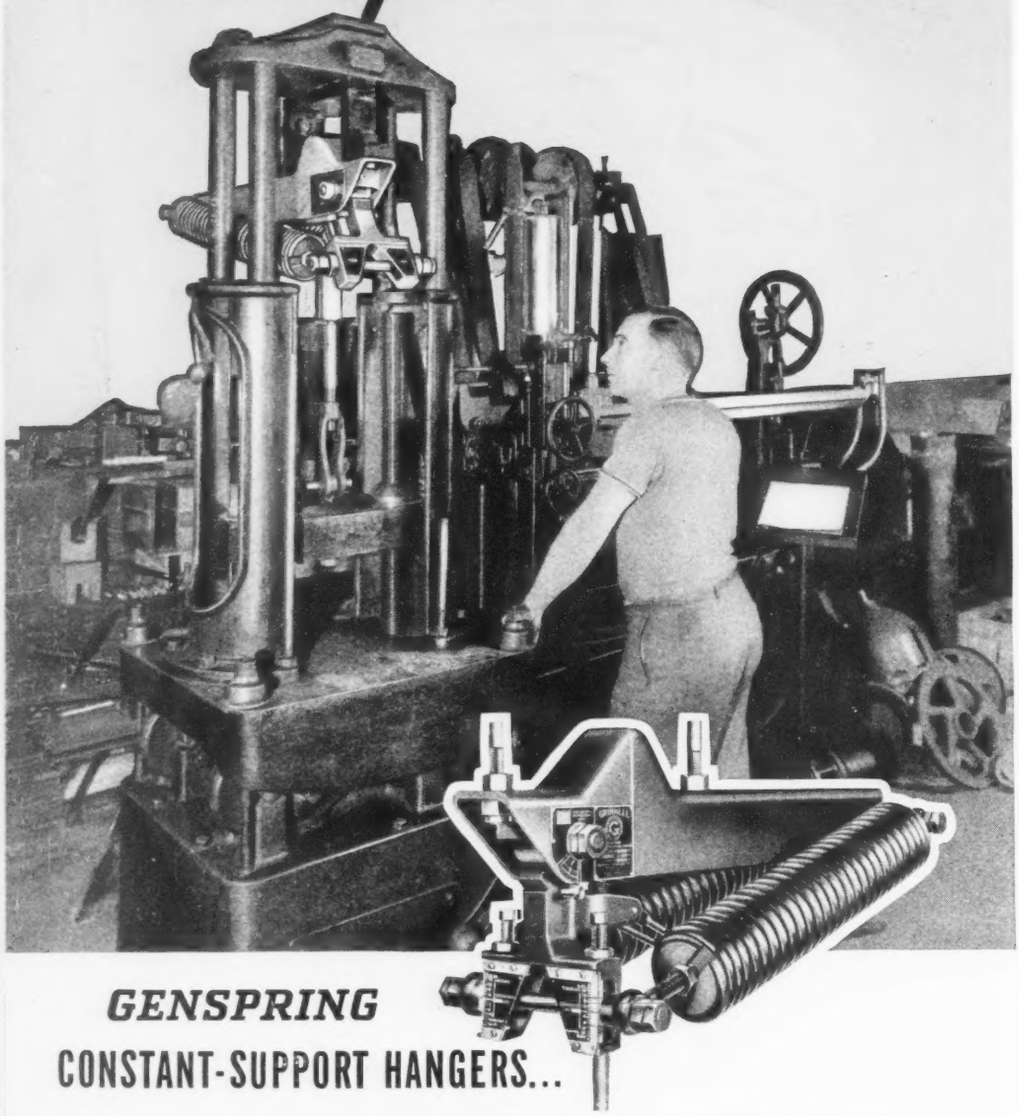
PRODUCTS for the PETROLEUM INDUSTRY

Flat Belting
V-Belts
Rotary Hose
Pump Intake Hose
Oil Loading Hose
Refinery Hose
Fueling Hose
Tank Car and Truck Hose
Fire Hose
Stuffing Box Rings
Gaskets and Packings
Rubber Covered Pistons
Pipe Joint Gaskets
Brake Lining
Molded Goods
Asbestos Products
Abrasive Wheels
Rubber Lined Tanks

E MANHATTAN RUBBER MANUFACTURING DIVISION
of RAYBESTOS-MANHATTAN, INC.
ECUTIVE OFFICES and FACTORIES • • • PASSAIC, NEW JERSEY

KEEP AHEAD WITH MANHATTAN

"Floating" PIPE-SUSPENSION



GENSPRING CONSTANT-SUPPORT HANGERS...

Calibrated for Each Installation

Before shipment to you, every GENSPRING Constant-Support Hanger for power piping is *individually* tested at the factory under load-and-travel conditions that duplicate the actual service specifications. However, should you find it necessary, field adjustments up to ± 16% of the hanger's rated load are easily made.

These are only two of the manufacturing and design features that make GENSPRING the outstanding hanger for today's high-temperature power service. Through unique engineering design GENSPRING Hangers provide constant support for piping in every "hot" and "cold" position. The weight of pipe is always in perfect balance . . . transfer of vertical vibration to the pipe structure is eliminated . . . the safety factor of the complete piping system is effectively maintained. Yet they require a minimum of headroom.

Investigate the exclusive advantages of GENSPRING Constant-Support Hangers available to support loads from 250 to 8500 pounds. Their cost is kept to a minimum through interchangeable parts and mass production. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of U. S. and Canada.

WRITE FOR complete Data Book on GENSPRING Hangers containing piping-travel calculations.

GENSPRING CONSTANT-SUPPORT HANGERS BY

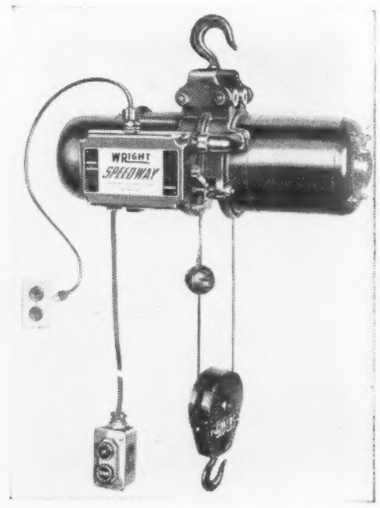
GRINNELL

WHENEVER **PIPING** IS INVOLVED

dle facilitate rapid production testing. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Electric Hoist

SPEEDWAY WIRE ROPE ELECTRIC HOIST, recently added to line, is obtainable in capacities from 250 to 1000 lb. Has



pushbutton control, weather-, acid-, and dust-proof preformed hoisting cable on drum winding, eliminating slack chain fouling loads, safety limit switches, safety load blocks. *Wright Mfg Div, York, Pa.*

Level Control

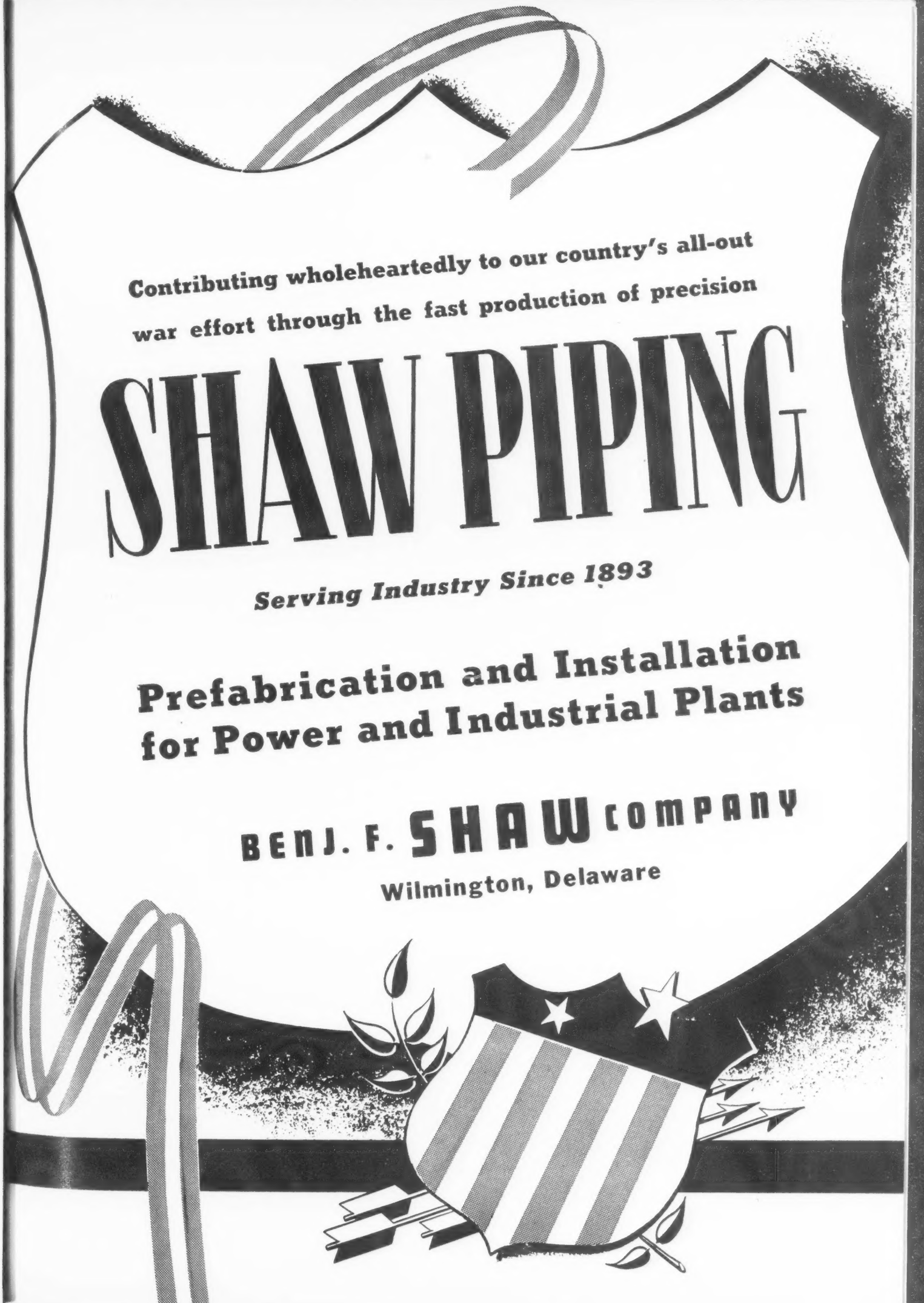
MAGNETROL UNIT IS ADDITION to present line. Flow alarm consists of full-ported globe valve body to which is attached patented Magnetrol magnetic switching arrangement. Switch head and valve-piston assembly are attached to valve body by a union bonnet nut, making removal for inspection simple. Units available in complete range of standard pipe sizes up to 4 in. *Automatic Control Div, Fred H Schaub Engrg Co, 325 W Huron St, Chicago, Ill.*

Rubber Putty

PLASTIKON IS RUBBER-BASE putty having unusual properties which make it suitable for many types of glazing and sealing. Said to be permanent, watertight and airtight. Solidifies and shrinks slightly, but does not become brittle, according to maker. Withstands vibration, expansion and contraction. *B F Goodrich Co, Akron, Ohio.*

Oil-Level Relay

OIL-LEVEL RELAY is intended for use with gravity-feed-type reservoir on oil-filled cable. Alarm switch is indirectly



Contributing wholeheartedly to our country's all-out war effort through the fast production of precision

SHAW PIPING

Serving Industry Since 1893

Prefabrication and Installation for Power and Industrial Plants

BENJ. F. SHAW COMPANY

Wilmington, Delaware

CELLU-LINED

Hydraulic Hose for High Pressures

OIL PROOFED with CELLULOSE

Cellu-lined hose is oil-proofed with multiple layers of cellulose, a material completely resistant to hydrocarbons, i. e.—hot oils, etc.

BURST PRESSURES to 23000 P.S.I.

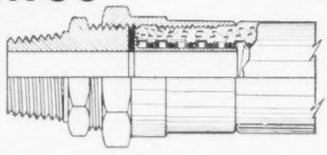
Great strength of Cellu-lined hose is obtained by imbedding metal braid covering in the synthetic casing.

SIZES 3/16" I.D. to 1 INCH I.D. (incl.)

Available sizes of Cellu-lined hose (I. D. measurements): 3/16", 1/4", 3/8", 1/2", 3/4" and 1".

CELLU-SEAL COUPLINGS

Couplings for Cellu-lined hose are available with standard I. P. T. or S. A. E. threads.



Write for Catalog and Engineering Recommendations on specific problems involving flexible connections.

CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

controlled by a hollow steel ball which fits inside the walls of a cylinder-shaped chamber enclosed in a nonmagnetic housing. At its lowest point the ball actuates a magnet which pulls down a hinged arm, causing alarm switch to close. Excess oil raises ball to chamber top, where a second tripping switch is located. Instrument's 2-switch controlling magnets can be adusted to cause an alarm before oil supply has been exhausted or before it rises too high. *General Electric Co, Schenectady, N. Y.*

Lubricating System

LINCOLN SYSTEM CONSISTS of a number of injectors, one for each bearing to be lubricated, each connected to bearing by tubing or high-pressure hose as required, and each individually adjusted to discharge the required amount of lubricant. Injectors can be mounted singly or in manifold, and are supplied with lubricant from a central pumping unit. Pumping unit on the installation illustrated is the new 2-part Centro-Matic pump. Entire system can be electrically operated with pushbutton control or automatic with time clock control. *Lincoln Engineering Co, 5701 Natural Bridge Ave, St. Louis, Mo.*

Blackout Coating

COATING IS SMOOTH-FLOWING liquid, manufactured from pyrobitumen ore, refined and mixed with quick-drying volatile solvents, and an ingredient which provides complete opacity and gloss-free surface. Can be sprayed or brushed on quickly, and can also be removed with any light petroleum solvent. *Carbozite Corp, First National Bank Building, Pittsburgh, Pa.*

Dust Collector

"DUSTKOP" UNIT-TYPE DUST COLLECTOR has 600 cfm rating and is designed for exhausting grinders, cut-off machines, and other tools. New model is equipped with 1/4-hp, 3450-rpm, 110-volt ac continuous-duty single-phase motor. Removal of collected dust and dirt accomplished by lifting louvered cover, taking out filter assembly and lifting out pan into which dust has fallen after being stopped by filter. *Aget-Detroit Mfg Co, Book Bldg, Detroit, Mich.*

Oscilloscope

PEAK-READING PORTABLE INSTRUMENT has been developed primarily for use in resistance welding, but may be applied to supplement other instruments used in troubleshooting. Unit has high-speed

PLANT USES JUST 1/3 AS MUCH OIL WITH

STANDARD OIL STEAM CYLINDER OILS

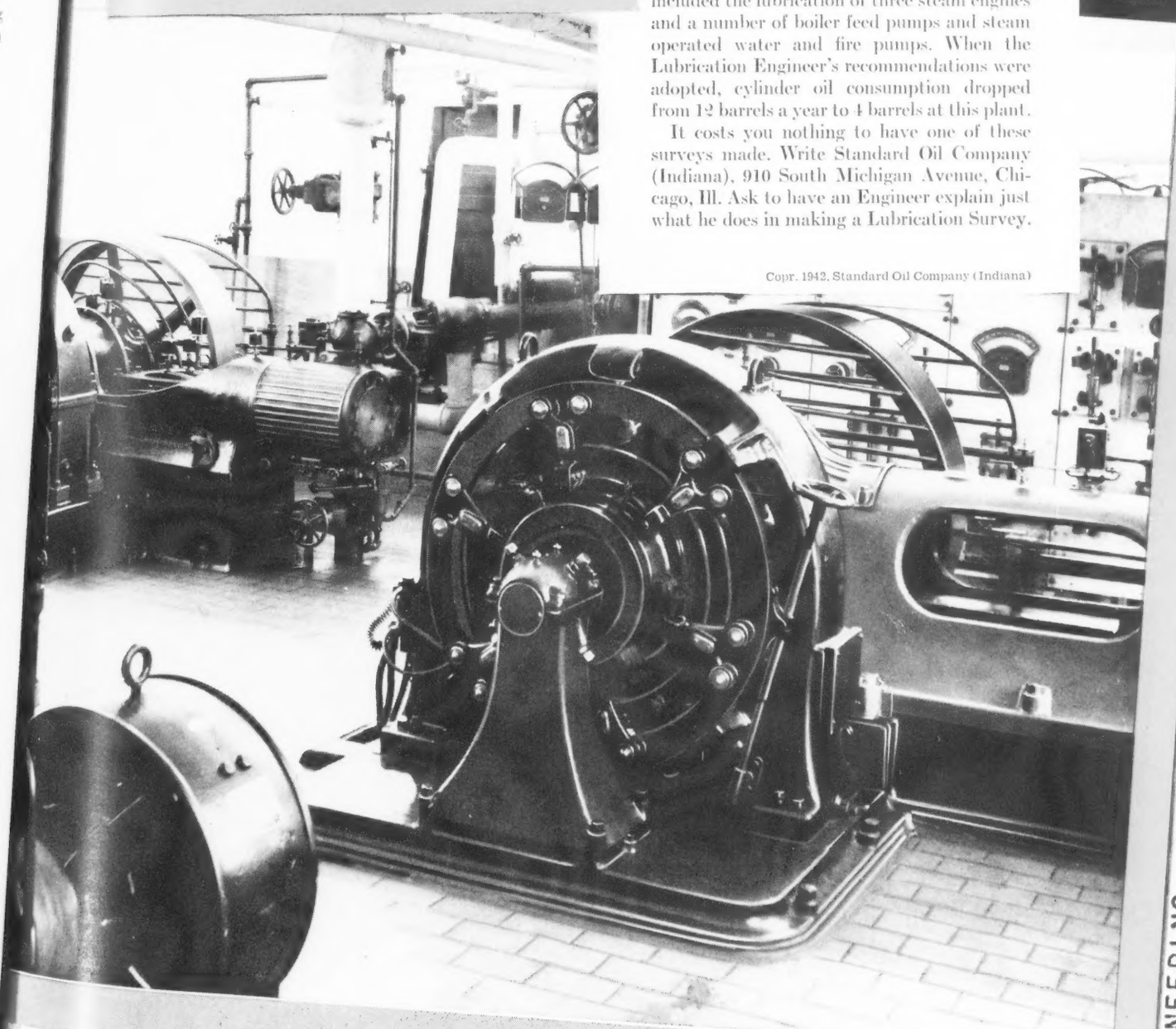
● WITH THE LOAD on your power plant steadily increasing—with equipment operating longer hours—you are probably watching maintenance and lubricating costs climb steadily.

No doubt you're also looking for every opportunity to check these rising costs. Here's a suggestion. Standard Lubrication Engineers are equipped to make a complete lubrication survey of your power plant. They'll go over your operating records with you. Where costs seem out of line they'll have a suggestion to make. You get a complete, written report of these suggestions.

One survey in a Wisconsin state institution included the lubrication of three steam engines and a number of boiler feed pumps and steam operated water and fire pumps. When the Lubrication Engineer's recommendations were adopted, cylinder oil consumption dropped from 12 barrels a year to 4 barrels at this plant.

It costs you nothing to have one of these surveys made. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Ill. Ask to have an Engineer explain just what he does in making a Lubrication Survey.

Copr. 1942, Standard Oil Company (Indiana)



STANDARD OIL COMPANY (INDIANA)

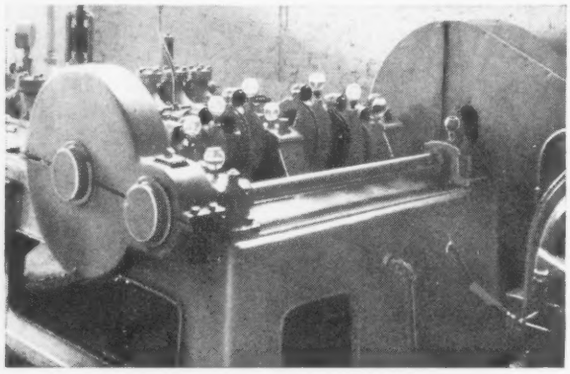
TION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEER

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENG

USES ONE-FIFTH AS MUCH OIL . . . TAKES ONE-FIFTH THE TIME FOR APPLICATION

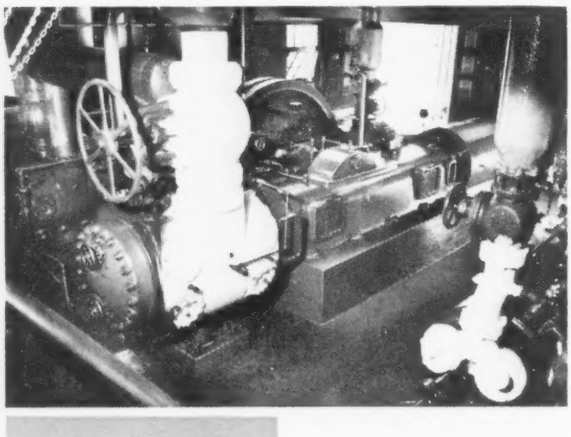
STANODRIP

The first gallon of Stanodrip tested in the bottle oilers on the homogenizer pictured below lasted 10 days. A gallon of the engine oil previously used had never lasted over two days. With no more trouble than it took to make this simple test, a Wisconsin manufacturer made an 80% cut in lubricating time and oil used on these machines.



The test was made when a Standard Oil Engineer was asked for his recommendation. He analyzed the operating conditions and picked Stanodrip, a high quality dripless oil, as the lubricant best fitted to meet them. The first gallon tested proved that Stanodrip would more than pay for itself in the oil and time it saved.

Let a Standard Oil Engineer test Stanodrip in some application in your plant.

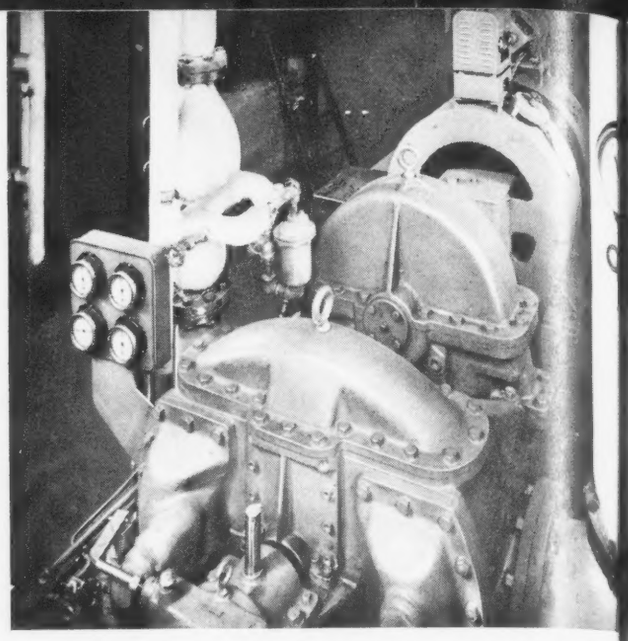


STANOIL

PROVED IN 24-HOUR SERVICE ON COMPRESSOR BEARINGS

Almost continuous operation, 24 hours a day, on an ammonia compressor in a Middle West packing plant gave Stanoil a severe two-year test.

Stanoil was used in the circulating system for bearing lubrication. After two years without bearing maintenance or lubricating difficulties of any kind, even under the severe operating conditions, there was no question about the oil to be used on a second unit being installed. Stanoil got the job. Test Stanoil yourself in a ring oiled bearing, speed reducer, or circulating system. See how it eliminates deposits that help cause bearing wear.



TIRED OF TRYING TO KEEP SMALL TURBINE OIL SYSTEMS CLEAN? TRY

NONPAREIL TURBINE OIL

Nonpareil Turbine Oil was developed to provide the safest possible lubrication for large, costly turbines operated by utility and industrial power plants. But it also offers operators of small turbines, such as the unit pictured above, a chance to eliminate considerable labor and maintenance.

Nonpareil has unusual stability against oxidation and sludge. That means the deposits which ordinarily collect in oil lines and gear cases on these units do not form with Nonpareil.

With a simple filter to remove foreign matter, and a small amount of make-up oil, all oil changes and oil system cleaning are eliminated.

Have a Standard Lubrication Engineer tell you why Nonpareil is the only oil with a written guarantee that *it will last as long as your turbine.*

• • •

WHY EXPERIMENT WITH LUBRICATION? SEE A STANDARD OIL ENGINEER FIRST!

As you get less and less time to spend on operating details, many of these details are becoming more and more important. Lubrication is one of them. But it's one operating problem on which you can get real help.

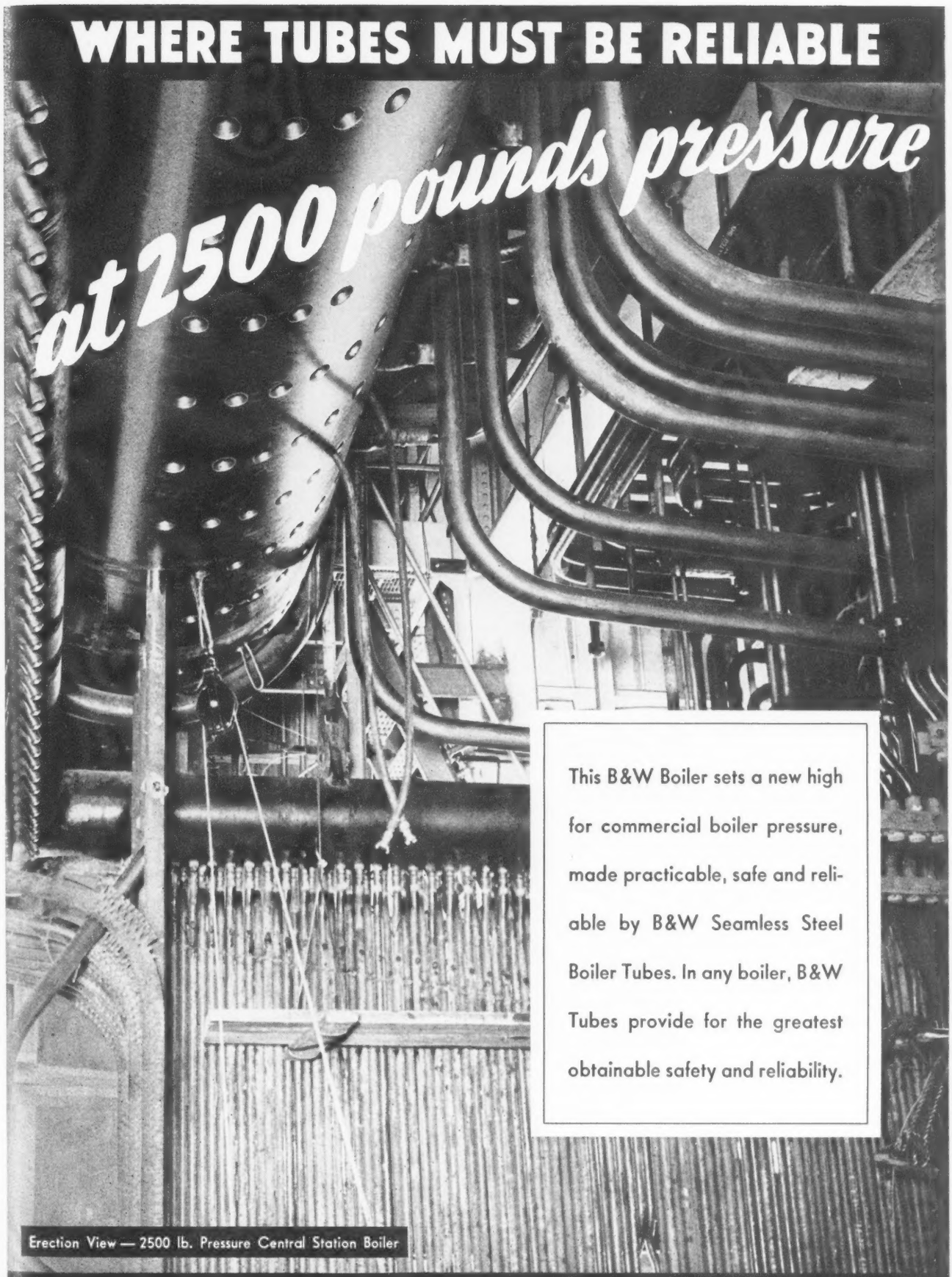
Instead of experimenting yourself with the new greases and oils to meet the higher speeds and heavier loads on power generating and transmission equipment, see the Standard Lubrication Engineer in your territory. He may have the answer to your problems right away. If he hasn't, you'll save time anyway, because he can call on the Standard Technical Service Department for help if it's needed.

Besides saving *your* time, you'll find that this Engineer's recommendations save lubricants, save machine time, save maintenance.

Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

WHERE TUBES MUST BE RELIABLE

at 2500 pounds pressure



This B&W Boiler sets a new high for commercial boiler pressure, made practicable, safe and reliable by B&W Seamless Steel Boiler Tubes. In any boiler, B&W Tubes provide for the greatest obtainable safety and reliability.

Erection View — 2500 lb. Pressure Central Station Boiler

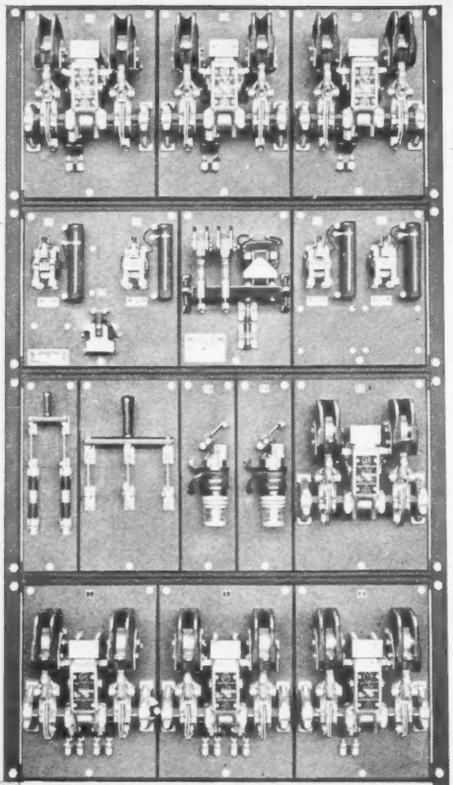
BABCOCK & WILCOX TUBES

THE BABCOCK & WILCOX TUBE COMPANY, BEAVER FALLS, PA.

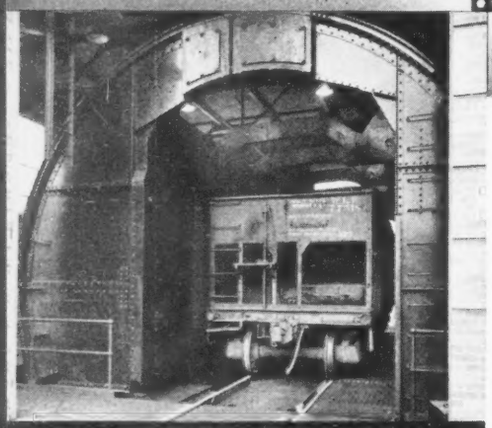
TA-1142

Smooth Acceleration

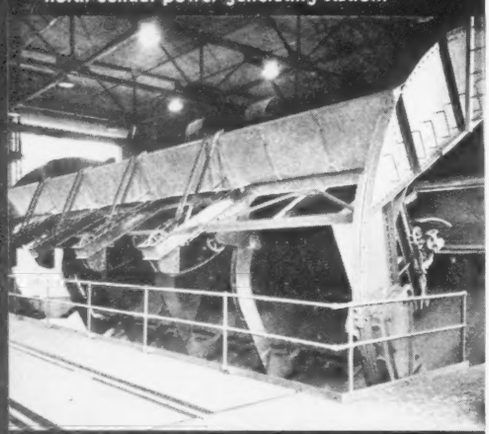
EC&M FREQUENCY RELAY MAGNETIC CONTROL



60 HP, 440 Volt EC&M Frequency Relay Magnetic Controller for car dumper illustrated below.



End view of Wellman Engineering Co. Rotary Car Dumper recently installed in north-central power generating station.



Car Dumper in extreme dump position. Limit Switches provide slowdown and stop at both limits of travel.

FROM standstill on the runway until the wheels leave the ground, the modern airplane increases in speed uniformly and smoothly over the entire distance required for the take-off.

Likewise, EC&M Frequency Relay Magnetic Control brings a-c wound-rotor motor-driven machines up to speed equally as smoothly and uniformly from the instant power is applied until the motor is running at full speed.

Besides being easy on the motor . . . and easy on the machinery during acceleration, this control can be designed to meet specific torque requirements for certain starting conditions such as encountered in wire drawing. In this instance, proper secondary resistance is chosen to give suitable starting and accelerating torque which will eliminate wire breakage and EC&M Frequency Relay Acceleration matches these pre-selected values to the load for smooth, safe acceleration.

Ask for Literature No. 930 on EC&M Frequency Relay Magnetic Control.

EC&M Frequency Relay Acceleration matches motor torque to the requirements of the load.

THE ELECTRIC CONTROLLER & MFG. CO. CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

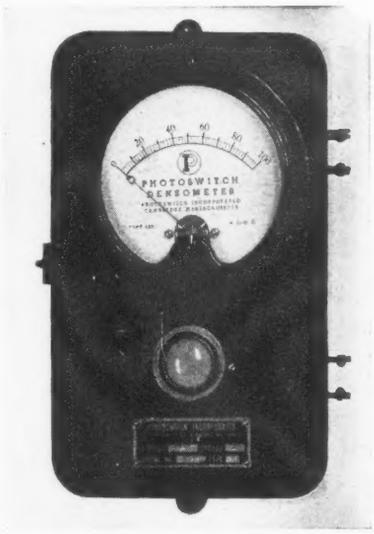
THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND OHIO

response to both current and voltage made possible by use of permanent-magnet oscillograph galvanometer. Magnitude, symmetry and uniformity of current were revealed by length, position and uniformity of a horizontal trace of light on the ground-glass view screen. *General Electric Co, Schenectady, N. Y.*

Smoke Alarm

PHOTOSWITCH SMOKE ALARM is said to increase combustion efficiency by indicating the degree of smoke density passing through the stack and signaling conditions of efficiency combustion and



excess smoke on green and red signal lights. Equipment includes photoelectric control, light source and indicator. Design of lens system mounting is said to minimize possibilities of soot and dust gathering on the lens. *Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.*

Thermostat

TYPE ASK-BB THERMOSTAT has silver contacts, and comprises a ½-in. bimetal element mica-insulated from a ½-in. spring. With maximum operating temperature of 300, 450 or 700 F, unit is capable of handling 1500 watts at 150 or 230 volts ac. Can be supplied either normally open or normally closed. *G Ulanet Co, E Kinney St, Newark, N. J.*

Insulation

MATERIAL IS MADE in form of a seamless braided tube of long-fibre asbestos with a wall thickness of ½ in. In applying, insulation is slipped on before assembly and is clamped at either end after being stretched tightly lengthwise on the pipe. Simple wire clamps available or ordinary hose clamp can be used. Supplied either plain or with a water- and grease-repellant coating. *Union Asbestos and Rubber Co, S 54th Ave, Cicero, Ill.*

ALLOYS

Timely information about metals . . .
CATALOGUED for your convenience

Specific answers to many of your questions about the selection, fabrication and uses of Nickel alloys are available to you quickly from our files.

This fund of helpful information we have gathered, checked and condensed into convenient printed form. The graphs, charts and shop guides are especially useful to men handling new materials or performing unfamiliar operations . . . and to new employees. This literature is available on request.

You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. These engineers are offering timely suggestions to many vital industries during the present emergency.

Why not drop us a card asking for list of available literature. Your request for the assistance will receive prompt attention.

NICKEL

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- Eliminates Rust, Scale and Corrosion the *natural* way.
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"BAERITE" IS..

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*a simple organic addition to water which duplicates "nature's own" method.

. . *NOT* a chemical dosage.

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. . already proved successful in hundreds of varied installations.

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*A special bulletin describes how the "Baerite" Simplified Water Treatment *duplicates* Nature's action in balancing waters to eliminate the problems of rust, scale and corrosion. Send the coupon below for your copy.

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Please tell me how "Baerite" duplicates Nature's method of "balancing" water.
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New Power Construction Construction to Come

Arizona-California—Bids Jan. 22, by Bureau Reclamation, Customhouse, Denver, Colo, for power transformers, switching equip, lightning arresters, voltage regulator, ground-fault neutralizer for Phoenix, Fort Huachuca, Tucson and Coolidge substations, Parker Dam Power Project, Spec 1023.

Arizona and Nevada—Bureau Reclamation, Custom House, Denver, Colo, bids early 1942, constructing Davis Dam. S O Harper, Custom House, Denver, Colo, engr.

Ark., Camden—Ark.-La. Electric Coop, % R I Davis, pres, Natchitoches, La, plans constructing steam power plant, $2,500,000.

Calif., Burbank—Bids Jan 20, by City Manager, City Hall, 272 Olive Ave, constructing steam power plant. Spec 265. Over $40,000.

Calif., Dutch Flat—Engineering Dept, Pacific Gas & Electric Co, 245 Market St, San Francisco, receiving bids constructing power house.

Calif., San Mateo—City plans constructing storm and sanitary sewers, sewage pumping station, equip, Laurel Gardens, Laurel Hills and Laurel Square Sub-division. Over $25,000.

Calif., Sunnyvale—Joshua Hendy Iron Wks, Sunnyvale, plans construction steam-turbine plant extension. Over $500,000.

Conn., Bridgeport—Jenkins Bros, B J Lee, gen mgr, 510 Main St, bids soon, constructing 5-story, 170x190 ft, brick, steel factory, for Navy Dept. $1,612,645. Structural steel, to Bethlehem Steel Co, 25 Bway, New York, N. Y. Defense Plant Corp will finance. Fletcher Thompson, Inc, 1336 Fairfield Ave, engrs.

Conn., Bridgeport—United Illuminating Co, 1119 Broad St, plans constructing steam plant extension, Steel Point Station, including high-pressure boilers. Over $40,000. Westcott & Mapes, Inc, 139 Orange St, New Haven, Conn., Engrs.

Conn., Waterbury—Waterbury Hospital, Bd Trustees, Robbins St, bids in January, constructing power plant and laundry. $175,000. Coolidge, Shepley, Bulfinch & Abbott, 1 Court St, Boston, Mass., archts. Office of Hollis French, 210 South St, Boston, Mass., engrs.

Georgia—Georgia Rural Power Reserve Electric Membership Corp, Louisville, plans constructing 756 mi 44-kv transmission line, and 3 steam generating plants. $3,750,000 REA allot.

Georgia—U. S. Engineers, 1 and Douglas Sts, N W, Wash., D. C., plans constructing dam and power house on Etawah River, Allatoona Project, near Carterville. Sanderson & Porter, 52 William St, New York, N. Y., engrs. $13,000,000.

Ill., Belleville—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., plans constructing steel foundry, machine shop, testing laboratories, near here. Operated by Walworth Co, under direct management Westcott Valve Co, 2133 Bond Ave, East St Louis. $3,000,000.

Ill., Geneseo—City plans improving municipal electric light and power plant, new diesel engine. Over $40,000. S Ogden, city engr.

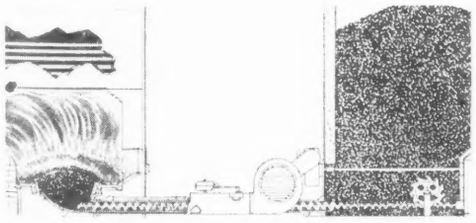
Iowa, Greenfield—Southwestern Federated Power Co-operative, Greenfield, A Ray, pres, plans constructing REA electric generating plant to serve four rural electric co-operatives in area, and transmission lines. Over $500,000.

Vultee
"Vengeance"
Dive Bomber

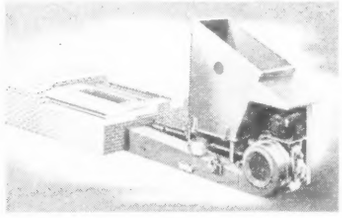
Vultee Installs 9 IRON FIREMAN STOKERS in its Great New Plant

EVEN in the fast-moving aviation industry, Vultee is known as a pace-setter. Vultee developed the first powered assembly line in the industry . . . and was one of the first to adopt the most modern firing method—Iron Fireman automatic coal firing—for its Nashville, Tennessee plant.

Here, nine Iron Fireman "Coal Flow" stokers provide the process and heating system steam that is needed to boost production to a maximum. Vultee reports the following accomplishments of Iron Fireman firing: A *steady* supply of steam, right around the clock, even after heavy withdrawals of process steam; no smoke nuisance; clean boiler room and surroundings.



BUNKER FEED. This is the type of Iron Fireman stoker adopted by Vultee. Built-in coal conveyor feeds coal direct from bin to the fire.



POWERAM. The heavy-duty power stoker. Combines worm feed with ram distribution of coal in retort.

Iron Fireman Can Do These Things for You

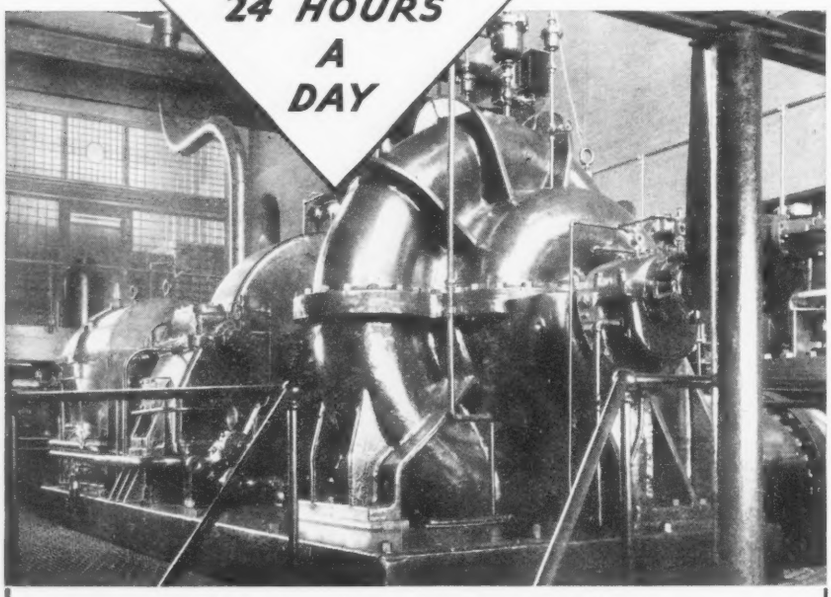
In hundreds of war-production plants, Iron Fireman firing is helping increase steam capacity—and boost production. In many cases, the adoption of Iron Fireman firing has eliminated the need for enlarged boiler capacity. For 18 years, Iron Fireman stokers have been setting low fuel-cost records in nearly all major industries.

Get the facts on how Iron Fireman helps meet today's increased steam demands. Read the 10 reports on typical users. Write for a copy of the new engineers' portfolio on the Iron Fireman Pneumatic Spreader method of firing. Iron Fireman Mfg. Co., Portland, Oregon; Cleveland; Toronto, Canada. Mail request to 3265 W. 106th St., Cleveland, Ohio.

IRON FIREMAN
Automatic Coal Stokers

Pumping Away for VICTORY

24 HOURS A DAY



30" Warren Single Stage, Double Suction Centrifugal Pump

WARREN PUMPS are ready to do their part to turn out an endless amount of material to win the war—for Warren Pumps are built to keep working efficiently and economically, if need be, 24 hours a day, year after year. Warren Pumps are designed and engineered right from start to finish. They have good details—liberal clearances . . . extra-heavy shafts . . . over size bearings . . . broad-faced case rings . . . properly proportioned liquid passages. You can *count* on Warren Pumps. Count also on the entire Warren organization to help in every possible way to bring *Victory* to our cause.

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THREE 42-YEAR-OLDERS GREET 1942

Recently Warren received orders for very minor repairs from three separate companies, for 3 Warren Pumps, each of which is still producing well after 42 years on the job. Warren Pumps will give *you* long, trouble-free service, too.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

Iowa, Waverly—City, R Clark, city clk, plans improving municipal light and power plant. $90,000.

Kan., Linsborg—City, E W Jernberg, mayor, voted $51,000 bonds, constructing power improvements.

Md., Annapolis—Bids about Jan. 20, by St Johns College, Annapolis, constructing boiler house. J R Edmunds, Jr, Calvert Bldg, Baltimore, archt. Crout, Snyder & Crandall, 20 E Lexington St, Baltimore, structural engrs.

Md., Fairfield (Sta. Baltimore)—Maryland Drydock Co, bids soon constructing power house. $60,000. J E Greiner Co, 1201 St Paul St, Baltimore, engrs.

Mass., West Roxbury—Bids Feb. 24, by Veterans Constr Bureau, Arlington Bldg, Wash., D. C., constructing 6-story hospital, storehouse, boiler plant, roads, walks, grading, draining.

Mich., Montague—Michigan Pub Serv Co, 148 E Front St, Traverse City, plans constructing 2000-hp diesel power plant, U. S. 31, north of city limits. $200,000.

Minn., New Ulm—City, A C Sannwald, city clk, plans furnishing, placing on foundation, 5000-kw turbine, municipal power plant. Over $40,000. R D Thomas & Associates, 1200 2 Ave S, Minneapolis, engrs.

Mo., Kennett—City plans constructing 100-kw diesel engine and generator power plant. $60,000. Burns & McDonnell, 107 W Linwood Blvd, Kansas City, Mo.

Neb., Omaha—Metropolitan Utilities Dist, W S Byrne, gen mgr, plans modernization, rehabilitation. Water Dept. plant and dist sys, $2,200,000. J P Detweiler, engr, Water Dept.

N. Y., Brooklyn—Dept Public Wks, Municipal Bldg, New York, plans constructing Newton Creek sewage treatment works. $6,600,000.

N. Y., New York—Dept Hospitals, 125 Worth St, plans constructing power plant expansion, Fordham Hospital, Bronx Boro, $825,000.

N. Y., North Beach—Dept Docks, Pier A, North River, New York, plans constructing emergency electric plant, $25,000; vehicular tunnel to seaplane administration bldg, $300,000 both at Municipal Airport 2, LaGuardia Field.

North Carolina and Tennessee—Western and North Carolina Electric Membership Corp, % B O Vannort, engr, Commercial Bank Bldg, Charlotte, N. C., surveys constructing 8 or 10 hydroelectric plants, steam-generating plant, 10 dams, on Watauga, Yadkin and New Rivers, to furnish power for 29 North Carolina counties and 2 Tennessee counties. $10,000,000. D B Crowell, Forest City, treas.

N. C., Southport—City plans constructing municipal power plant addns, extens, $46,142.

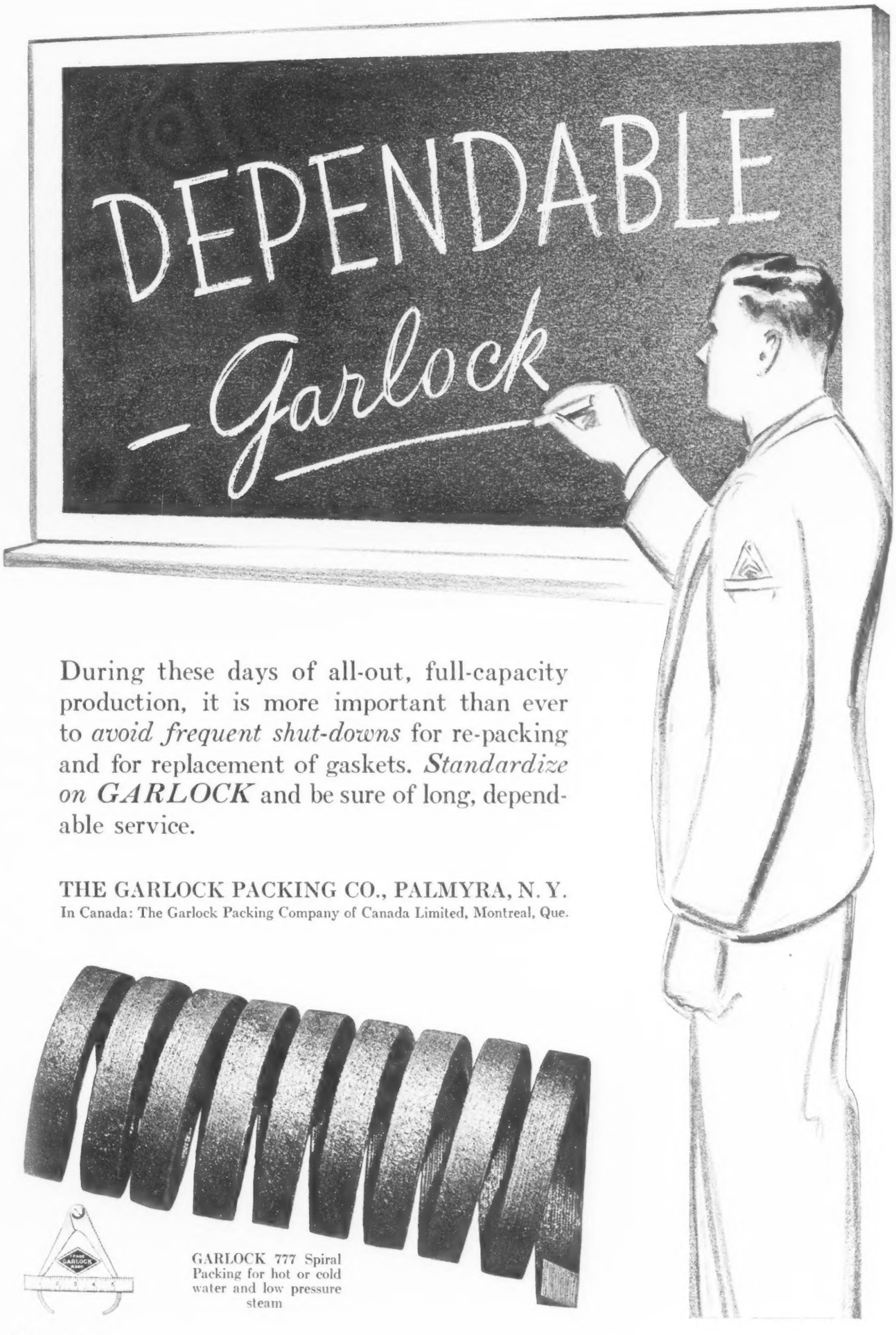
N. C., Tarboro—City, G F Fountain, Jr, mayor, plans constructing power plant improvements. $210,000 bond election in several months.

Ore., Fairview—Aluminum Co of America, Gulf Bldg, Pittsburgh, Pa., preliminary plans doubling capacity aluminum fabrication plant. $10,000,000. Defense Plant Corp will finance.

Ore., Pendleton—Bids Jan. 20, by U S Eng, 628 Pittock Blk, Portland, constructing bomb trainer bldg, transformer substation, utilities, Pendleton Field.

Ore., Troutdale—Aluminum Co of America, Gulf Bldg, Pittsburgh, Pa., preliminary plans doubling capacity aluminum reduction plant. $12,000,000. Defense Plant Corp will finance.

Pa., Braddock—Carnegie Illinois Steel



During these days of all-out, full-capacity production, it is more important than ever to *avoid frequent shut-downs* for re-packing and for replacement of gaskets. *Standardize on GARLOCK* and be sure of long, dependable service.

THE GARLOCK PACKING CO., PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

GARLOCK 777 Spiral Packing for hot or cold water and low pressure steam

AIR WHERE YOU NEED IT

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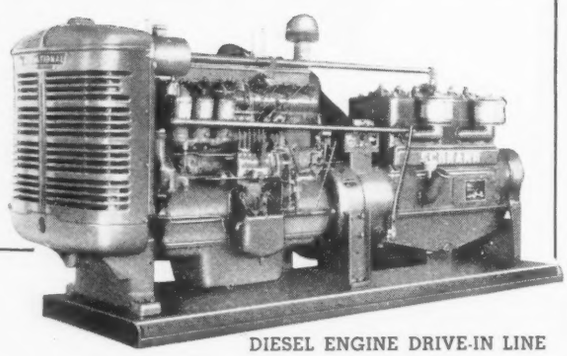
AT MINIMUM COST



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SCHRAMM Stationary Air Compressors provide the means of supplying compressed air service right where it's needed for maximum convenience and use.

MODERN engineering contributing to economical operation with smooth, vibrationless performance—compact dimensions, no foundation needed.

AUTOMATIC control operates the compressor only when required; giving the correct amount of air constantly.

FORCE FEED lubrication saves maintenance, no care or up-keep necessary. Save money with a SCHRAMM—in time, space and operation.

Built in sizes
from 20 to 600
cu. ft. displacement

Write for Catalog 42-S

SCHRAMM, INC., WEST CHESTER, PA.

SCHRAMM *Air Compressors*

Corp, M W Reed, ch engr, Carnegie Bldg, Pittsburgh, receiving bids for 2 blast furnaces. Defense Plant Corp will finance.

S. D., Pierre—State plans constructing dam, Missouri River, near here. Estimated $100,000.

Tennessee—Tennessee Valley Auth, Knoxville, plans constructing Douglas Dam in French Broad River. $32,000,000. OPM asked Congressional approval.

Texas, Camp Barkeley—Bids Jan. 6, by U. S. Eng, Camp Barkeley, additional heating unit, boiler house, service pipe dist lines, etc.

Texas, Edinburg—City, A A Aldrich, mayor, bond election January 15, constructing electric power plant, dist sys, $500,000.

Texas, Katy—Stanolind Oil & Gas Co, Gulf Bldg, Humble Oil & Refining Co, Humble Pipe Line Co, both Humble Bldg, Houston, receiving bids constructing gas recycling plant. $3,250,000.

Utah—Garkane Power Assn, Inc, R A Middleton, mgr, Hatch, surveys, etc, constructing, acquiring 205 mi lines, constructing generating plant. $213,000 REA allot. W W Flora, 1618 Flora St, Cheyenne, Wyo., engr.

Utah, Ogden—Bids Jan. 5, by U. S. Eng, Salt Lake City, constructing steam, condensate return and air lines to inert bldg and steam and condensate return lines to administration bldg, Ogden Ordnance Depot.

Utah, Provo—Columbia Steel Co, Russ Bldg, San Francisco, Calif., plans constructing plant for use in production pig iron, steel and steel plates, near here, for OPM. $91,000,000. Defense Plant Corp will finance.

Washington—Bids Jan. 15, by Bureau Reclamation, Customhouse, Denver, Colo, for generators for Units L-7, L-8 and L-9, Grand Coulee Power Plant, Columbia Basin Project, Spec. 1018.

Washington—Bids Jan. 28, by Bureau Reclamation, Customhouse, Denver, Colo., for main and auxiliary control, load and frequency control and station service dist equip, 6,900 volt switchgear for Units L-4 to L-9 (inclusive) Grand Coulee power plant, Columbia Basin project, Spec. 1022.

Wash., Tacoma — Bonneville Power Admin, P O Box 3537, Portland, Ore, plans constructing substation tieing in with Tacoma municipal sys, to serve 40,000,000 lb aluminum reduction plant. $1,000,000. Defense Plant Corp will finance.

Wis., Genoa—Tri-State Power Co-operative, Genoa, J N Gundershaug, mgr, plans constructing additional facilities in connection with generating plant. $48,000 REA allot.

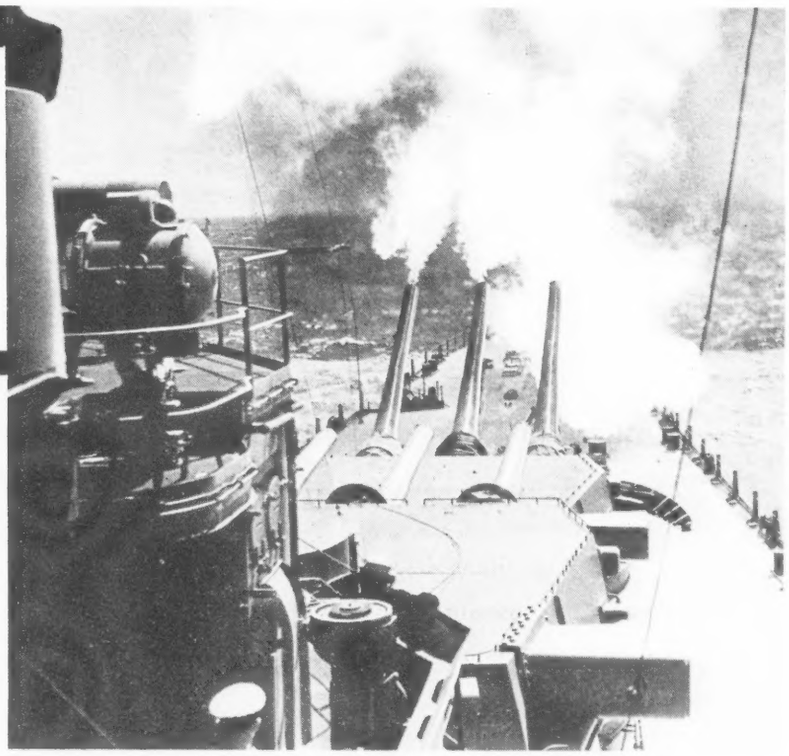
Wis., Milwaukee—A O Smith Corp, 3533 W 27 St, awarded contract constructing masonry and concrete work 1-story, 70x102-ft, brick, steel, boiler house, concrete fdn, to Hunzinger Const Co, Station K. E W Burgess, ℄ owner, engr.

Wis., Stiles—Oconto Electric Co-operative, Oconto Falls, plans constructing hydro-electric power plant, enlarging dam. $200,000 REA. Orbison & Orbison, 206 W College Ave, Appleton, engrs.

Wis., Waterloo—Bids Jan. 6, by Water & Light Comm, Waterloo, altering, enlarging electric generating and central heating plant. $104,000. Commercial Testing & Eng Co, 307 N Michigan Ave, Chicago, Ill., engrs.

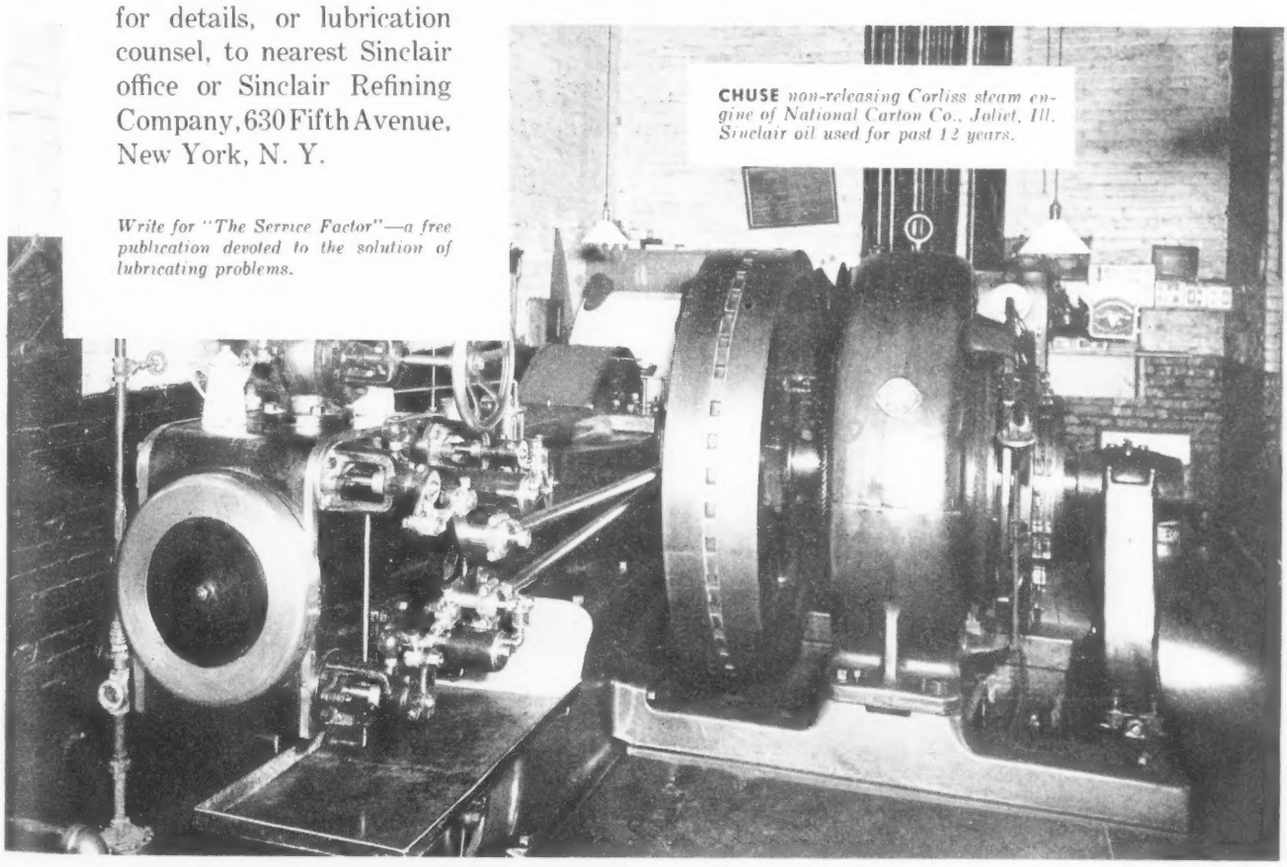
P. R., San Juan—The Puerto Rico Gas & Coke Co, San Juan, plans extending power plant, new steam generator, $150,000.

WAR PRODUCTION tolerates no slow-downs. Don't allow inadequate lubrication to reduce engine efficiency. For *STEAM ENGINES* there are . . .



. . . SINCLAIR STEAM CYLINDER and VALVE OILS that provide *correct* power plant lubrication. These oils are available to meet any combination of pressures, temperatures, moisture conditions, and steam recovery requirements of your power house. Write for details, or lubrication counsel, to nearest Sinclair office or Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



CHUSE *non-releasing Corliss steam engine of National Carton Co., Joliet, Ill. Sinclair oil used for past 12 years.*

SINCLAIR INDUSTRIAL OILS

SINCLAIR REFINING COMPANY (Inc.)

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WELDOLETS·
TRADE MARKS - REG. U.S. PAT. OFF.
THREDOLETS
. . . Welded Outlets for Piping . . .

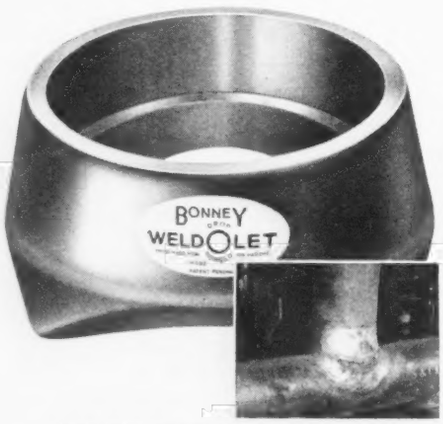
They Meet Every Need for Making Welded Right-Angle Branch Pipe Outlets

WeldOlets

Standard stock welding fittings of drop forged steel, designed for making any type or combination of right-angle branch outlets. Branch outlet pipe is attached by beveling end at 45° and welding to fitting. WeldOlets provide leakproof junctions, which because of their patented design, are of full pipe strength.

ThredOlets

ThredOlets are similar in design to WeldOlets except that their outlet is tapped to standard taper pipe sizes. Like WeldOlets and Socket-End WeldOlets, they eliminate the necessity of preparing preliminary layouts of the main pipe and branch. No templets are used, nor is it necessary to do complicated cutting, forming and fitting of the main pipe.



Socket-End WeldOlets

Socket-End WeldOlets are similar to WeldOlets and ThredOlets except that their outlets are bored to accept standard outside pipe diameters. They simplify alignment of the branch and eliminate all beveling end threading of the branch pipe.

WeldOlets, ThredOlets and Socket-End WeldOlets are available in size-to-size and reducing sizes for all standard pipe sizes. They are suitable for use in every type of piping system and for all commonly used pressures and temperatures. To meet special conditions or for extremely high pressures and temperatures, extra-heavy types are available on special order.

Write today for copy of Bulletin WT29, giving all the advantages of WeldOlets and ThredOlets.

BONNEY FORGE & TOOL WORKS
Forged Fittings Division - Allentown, Pa.
Forged by the Makers of
The Finest that Money Can Buy
BONNEY TOOLS

Contracts Let

Ala., Gadsden—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., awarded contract constructing heat treating bldgs, Gadsden shell plant, to Rust Eng Co, Martin Bldg, Birmingham. $124,053.

Arizona-California — Bureau Reclamation, Customhouse, Denver, Colo., awarded contract for structural steel for bus structure assembly, Parker power plant, Parker Dam Power Project, Spec 1586-D to Creamer & Dunlap, 1900 W 21 St, Tulsa, Okla., $30,854.

Arizona-California-Nevada — Bureau Reclamation, Customhouse, Denver, Colo., awarded contract for 168-in. butterfly valves, Boulder power plant, Boulder Canyon Project. Spec 1011, to Hardie-Tynes Mfg Co, 800 N 28 St, Birmingham, Ala, $179,000.

Arizona-California-Nevada — Bureau Reclamation, Customhouse, Denver, Colo., awarded contract furnishing equip for modernizing oil circuit breakers in switchyard, Boulder Dam power plant, to Westinghouse Electric & Mfg Co, G & E Bldg, Denver, Colo. $120,000.

Arizona-California-Nevada — Bureau Reclamation, Custom House, Denver, Colo., awarded contract for 3 transformers for switchyard and power plant, Boulder Dam, Colorado River, to Westinghouse Electric & Mfg Co, G & E Bldg, Denver, Colo. $325,120. Bids 11/6.

Ariz., Miami—Castle Dome Copper Co, subsidiary Miami Copper Co, 61 Bway, New York, N. Y., awarded contract constructing copper plant to W A Bechtel Co, 155 Sansome St, San Francisco, Calif. Est. $9,000,000. Defense Plant Corp will finance.

Ark., Pine Bluff—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., awarded contract for design and construction Pine Bluff Arsenal for Chemical Warfare Service, near here, to Sanderson & Porter, 52 William St, New York, N. Y. $8,625,000.

California—Bureau Reclamation, Customhouse, Denver, Colo., awarded contract for three 25,000-kilovolt-ampere power transformers for Keswick power plant, Central Valley Project, Spec 1008, to General Electric Co, 650 17 st, Denver, Colo. $559,785.

Calif., Sacramento—U. S. Eng, Federal Bldg, awarded contract constructing steam boiler plant, McClellan Field, to C C Moore & Co Engineers, 450 Mission St, San Francisco, $238,965.

Calif., Mare Island—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., awarded contract constructing additional shipbuilding facilities, Navy Yard, Contr, NOY 5107, to The Kaiser Co, Box 8, Navy Yard, Mare Island. $5,624,000.

Calif., Mather Field—U. S. Eng, 208 Post Office Bldg, Sacramento, awarded supplemental contract constructing additional bldgs, also landing strips, runways, taxiways, to E J Twaits Co, 816 W 5 St, Los Angeles, $1,102,285 and $875,285, respectively.

Calif., Moffett Field—National Advisory Com for Aeronautics, Ames Laboratory, Moffett Field, awarded contract constructing fabricated steel wind tunnel, Moffett Field, to Pittsburgh-Des Moines Steel Co, Rialto Bldg, San Francisco. $5,202,320.

Calif., San Francisco—Regents University of California, Berkeley, awarded contract constructing generator plant for University of California Hospital, to

Message to Garcia 1942 Style

In '98, Rowan struggled in the jungles of Cuba three weeks to deliver his message to Garcia. Today, there is hardly a military commander in any American outpost--from Iceland to the Philippines--who can't be reached in an hour or less from Washington, by plane or telephone or short-wave radio.

In this revolution in communication, steel has had a vital part. Steel not only goes into the delicate instruments of the Signal Corps, but also plays essential roles in the form of conduit, copperclad steel wire, aerial towers, and other equipment of many kinds.

For many months, a sizable percentage of Youngstown's production has been going into materials for defense use, including the Signal Corps -- conduit, pipe, wire, rods, bars, shapes, sheets, strip and plate. As we help to speed messages by the hundreds of thousands to our modern Garcias, we are insuring that tomorrow America may enjoy the peacetime products of our mills and factories.

Youngstown products include Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes 25-28D

QUALITY TRADE MARK YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

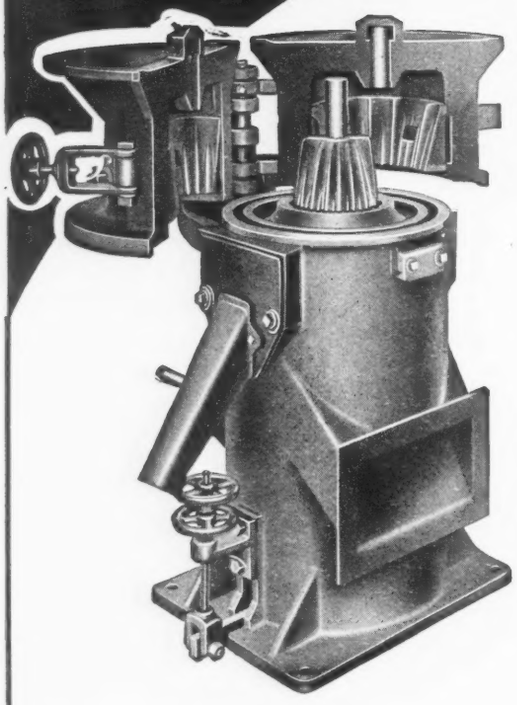
Manufacturers of Carbon, Alloy and Yoloy Steels

General Offices - YOUNGSTOWN, OHIO

What are you doing to keep coal costs down while steam demands go up?

Have you tried buying B.T.U.'s figured from testing coal *with the...*

IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER and SAMPLER



When you buy your coal on a strict B.T.U. basis you avoid paying for impurities. It's good business and good operation to buy coal this way because it avoids argument and gives you a basis for cost comparison. Besides when you know your B.T.U.'s you can save money and insure better boiler performance.

And the way to buy coal right is to sample it accurately, quickly and at low cost the automatic "STURTEVANT WAY." By replacing hit-or-miss hand sampling the Sturtevant Coal Crusher & Sampler eliminates 32 out of 34 operations.

HERE'S HOW IT'S DONE

Coal or coke fed into the machine is crushed between fine toothed crushing disc and stationary liner and thoroughly mixed to a truly representative correctly proportioned mixture.

This finely crushed material (approximately 8 mesh and finer) is uniformly discharged in 5, 10 or 15% samples as desired through "sample" spout thoroughly and automatically prepared for test. The possibility of human error is completely eliminated. Samples of coal prepared by the "STURTEVANT" method can therefore be depended on as being truly representative.

This improved machine, requiring only 3 H.P. is sturdy, long-lived, compact and convenient and provides the means for instant sampling. WRITE TODAY FOR COMPLETE INFORMATION BY ASKING FOR Bulletin 85.

For Savings . . .

"SAMPLE YOUR COAL BEFORE YOU BURN IT"

Sturtevant Mill Co.

103 Clayton St., Dorchester, Boston, Mass.

W S Leland Co, 55 New Montgomery St. $121,810.

Colorado—Bureau Reclamation, Customhouse, Denver, awarded contract for 3 transformers and 5 oil circuit breakers for Green Mountain Power Plant, Colorado-Big Thompson Project, Spec 1002, to Allis-Chalmers Mfg Co, Continental Oil Bldg, Denver, $143,350, 7 transformers, to Pennsylvania Transformer Co, 1701 Island Ave, Pittsburgh, Pa., $54,698; 47 disconnecting switches to Memco Eng & Mfg Co, 37-46 9 St, Long Island City, N. Y., $10,570. Grand Total $208,618.

Conn., Devon—Connecticut Light & Power Co, C L Campbell, pres, 49 Leavenworth St, Waterbury, will construct 45,000 kwhr capacity power plant. Owner builds. $4,000,000.

Conn., Groton—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., awarded contract constructing 4-story, 65x223 ft and 2-story, 64x124 ft warehouse, laundry, fire station, garage, all brick, submarine base, to F H McGraw & Co, 780 Windsor St, Hartford, $1,000,000.

Conn., Hamden—Acme Wire Co, 1255 Dizwell Ave, awarded contract constructing power plant, to Mott-Mohr Constr Co, Inc, 440 Elm St, New Haven. Est. $60,000.

Conn., Naugatuck—Naugatuck Chemical Div, U. S. Rubber Co, Naugatuck, awarded contract constructing 2-story, 80 x 180 ft, brick, steel, concrete factory, also tanks, substation, administration bldg, to W J Megin, Inc, 51 Elm St, Naugatuck; underground piping, to C N Flagg & Co, Inc, 79 Griswold St, Meriden, Est $2,250,000. Defense Plant Corp will finance.

D. C., Wash.—Potomac Electric Power Co, 10 and E sts, awarded contract for design and construction electric power bldg, 33 V St S W, to Stone & Webster Eng Corp, 49 Federal St, Boston, Mass. Est. $700,000.

Florida—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., awarded contract supplemental agreement—additional facilities, Naval Air Sta and Naval Hospital, Jacksonville, and Naval Air Sta, Banana River, to Duval Eng & Contg Co, The Geo D Auchter Co and Batson-Cook Co, foot of E Adams Sts, Jacksonville. Est $2,514,401 incl fee.

Fla., Key West—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., awarded contract supplemental agreement naval hospital, Contr NOY 4849, to The Mackle Co & Leach Constr Co, 2818 Coral Way, Miami. Est $800,000 incl fee.

Ill., Aurora—Sargent & Lundy, engrs, 140 S Dearborn St, Chicago, awarded contract constructing superstructure power plant addn, for Western United Gas & Electric Co, Aurora, to Chas E Giertz & Son, 57 Douglas St, Elgin. Total est. $500,000.

Ill., Chicago—Youngstown Sheet & Tube Co, 111 W Washington St, awarded contract constructing power plant, 9355 S Kreiter Ave, to Rust Eng Co, Clark Bldg, Pittsburgh, Pa. Est. $100,000.

Ill., Dixon—Illinois Northern Utilities Co, Dixon, will construct generating plant to house 50,000-kw turbo-generator, separate contracts. $6,000,000. Sargent & Lundy, 140 S Dearborn St, Chicago, engrs.

Ill., Princeton—City awarded contract for turbo-generator, for municipal light and power plant imprvs, to General Electric Co, 1 River Rd, Schenectady, N. Y. $45,650.

Ill., Rockford—Central Illinois Electric & Gas Co, D C McClure, pres, 300 N Main St, awarded contract for design and con-

. . . America's biggest "insulation" job!

IT is really an insulation job that faces America today—insulating Democracy against Dictatorship.

With this goal the Keasbey & Mattison Company is in full and enthusiastic accord. We like what is called the "American Way," its concern for the freedom of the individual, its aspirations for a peaceful world.

It is only natural, then, that the Nation has first call on K&M plants and employees. Our whole productive capacity has been dedicated to the cause of defending Democracy.

While working at top speed, we are not forgetting that the future will bring demands for improved asbestos products . . . and new products too. Our engineers and research men are working now on better materials for tomorrow.

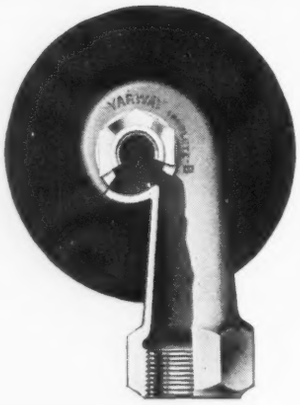
Perhaps you can assist us. In what way can asbestos make your work easier or help solve some particular difficulty? Any suggestions will be carefully considered in the hope that they will prove practical from a manufacturing standpoint. We'd appreciate a letter from you.

* * *

Nature made asbestos; Keasbey & Mattison has made it serve mankind . . . since 1873.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

YARWAY
INVOLUTE SPRAY NOZZLES



Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-615.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

construction power plant addn, to Stone & Webster Engineering Corp, 90 Broad St, New York, N. Y., $1,350,000.

Ill., Washington Park (Branch East St Louis)—Westcott Valve Co, A V Wadsworth, vice pres, 2133 Bond Ave, East St Louis, awarded contract constructing steel castings and valve plant, 3 bldgs, for Navy Dept, 57 St, Industrial Ave, near B & O R R tracks, to Rust Eng Co, Clark Bldg, Pittsburgh, Pa. Est incl equip $3,000,000. Defense Plant Corp will finance.

Ill., Waukegan—American Steel & Wire Co, 208 S La Salle St, Chicago, awarded contract constructing steel plant addns, to R Borregard, 1305 W Grand Ave. Total est $10,000,000 including equip.

Ind., Fort Wayne—General Electric Co, 1635 Bway, awarded contract for turbo superchargers and geared impeller plant for War Dept to Stone & Webster Eng Corp, 49 Federal St, Boston, Mass. $8,000,000. Defense Plant Corp will finance. Cost with equip, $25,011,838.

Kan., Winfield—City, F E Jarvis, mayor, awarded contract installing power piping, power plant, to Power Serv Co, Wesley Temple Bldg, Minneapolis, Minn., ($25,775.) Est. $25,000.

La., New Orleans—Todd-Johnson Dry Docks, Inc, Hinds Lane Wharf, awarded contract constructing 18,000-ton brick, steel floating drydock, to Chicago Bridge & Iron Co, Chicago, Ill. Est $2,500,000. Defense Plant Corp will finance. Frederic R Harris, Inc, 27 William St, New York, N. Y., engrs.

Md., Sparrows Point (Br Baltimore)—Bethlehem Shipbuilding Co, awarded contract constructing 3 steel, concrete shipways and shop bldg for U. S. Maritime Com, 14 St between E St and Constitution Ave, N. W., Wash., D. C., to McLean Contg Co, 1301 Fidelity Bldg, Baltimore, est $2,000,000.

Mass., Boston—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., awarded contract constructing shipbuilding dry dock, Navy Yard, Contr NOY 5080, to J F Fitzgerald Constr Co, 214 Essex St, $1,500,000.

Mass., Indian—Orchard-Chapman Valve Co, Pinevale, Indian Orchard, awarded contract for design and construction 1-story, 75 x 300 ft, brick steel machine shop, 1-story 480 x 600 ft foundry to Stone & Webster Eng Corp, 49 Federal St, Boston. Est $3,000,000. Defense Plant Corp will finance.

Mass., Pittsfield—General Electric Co, Morningside St, W H Milton, Jr, mgr Plastic Dept, awarded contract constructing 4 units, brick steel phenol plant, to The Lummus Co, 420 Lexington Ave, New York, N. Y. Est $1,000,000.

Minn., New Ulm—A D Sannwald, city clerk, awarded contract for one 5000-kw turbine-generator in municipal power plant, to Elliott Co, 220 Baker Bldg, Minneapolis, $120,045.

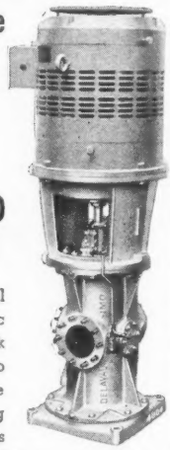
Minn., Willmar—City, E H Brogren, city clerk, awarded contract imprv, extension to power plant to Nelson Bros Const Co, Willmar, $50,000.

Mo., St. Louis—Union Electric Co of Missouri, 12 and Locust Sts, awarded contract constructing electric power substation, to Vernon Higbee Const Co, 6504 Nashville Ave. Est. $40,000 with equip.

Mo., Fort Leonard Wood—Con QM Fort Leonard Wood, awarded contract constructing incinerator, to E Brunson Constr Co, Ry Exch Bldg, St. Louis, Mo., $27,275.

Mo., Independence—Remington Arms Co, Inc, Barnum Ave, Bridgeport, Conn., awarded supplemental contract constructing two 100x300 ft brick bldgs in con-

LARGE CAPACITY...
in Small Space



IMO must MOVE OIL

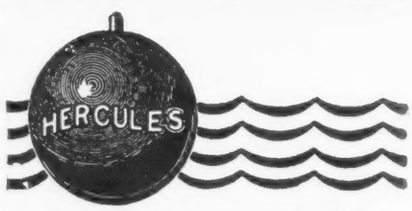
De Laval-IMO Oil Pumps

for lube and fuel oil and for hydraulic pressure service pack great capacity into small space. The one shown, delivering 700 g.p.m., occupies only 30 in. square of floor space. It has only three moving parts and runs at standard motor or turbine speeds. Built in all capacities and for all pressures.

Ask for Catalog I-88

IMO PUMP DIVISION
of the De Laval Steam Turbine Co.
Trenton, New Jersey

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

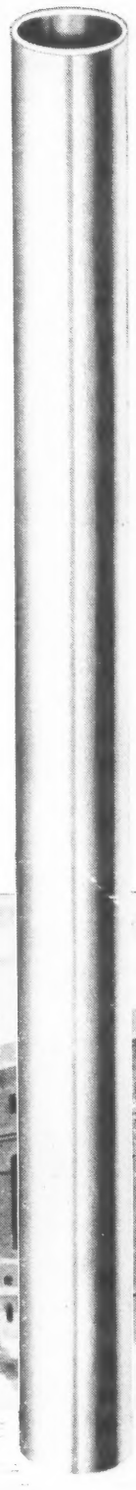
HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

G-L-O-B-E SPELLS SAFETY AND SAVINGS IN PRESSURE TUBES

Service records in many of the nation's noteworthy power plants — their use by leading railroads, industrial and marine boiler builders — attest the greater value, safety and savings of Globe Steel Tubes.

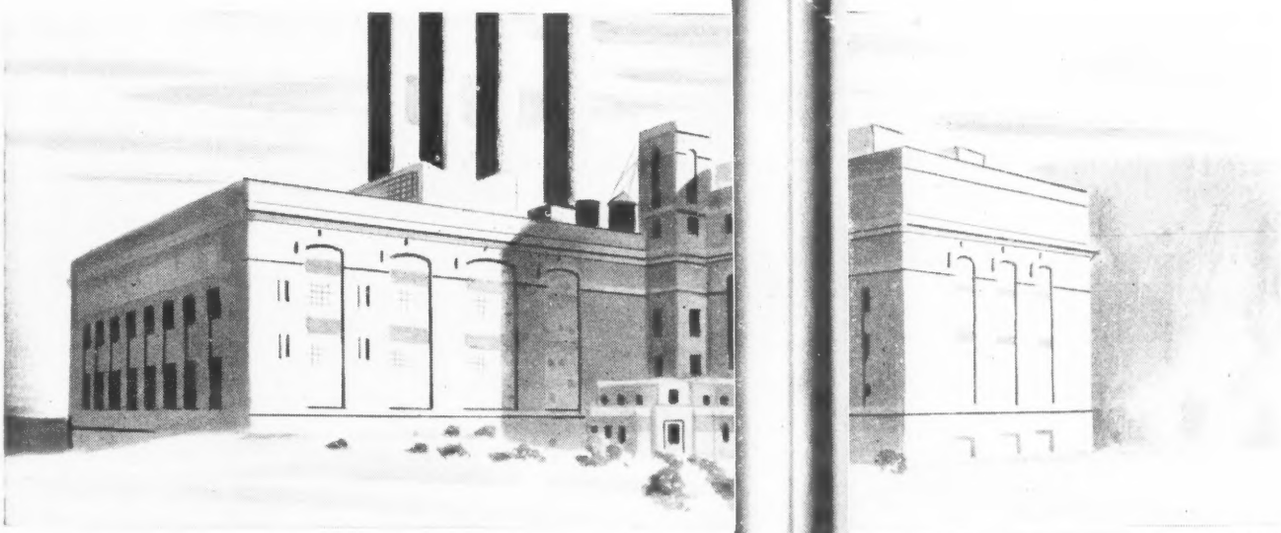
Their extra margin of safety and strength — particularly vital to meet modern high pressure and temperature demands — more than offsets any immediate advantage of lower first cost.

GLOBE STEEL TUBES CO.



Globe engineers are always available to assist in selecting a tube with the exact characteristics you require.

MILWAUKEE, WIS.



1000

GLOBE TUBES

GLOBE STEEL TUBES

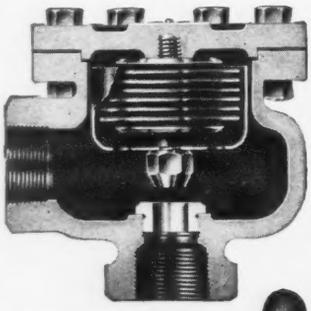
- Stainless Tubes
- Condenser and Heat Exchanger Tubes
- Boiler Tubes
- Mechanical Tubing

IN THESE DAYS OF ALL-OUT PRODUCTION

you need **NICHOLSON**

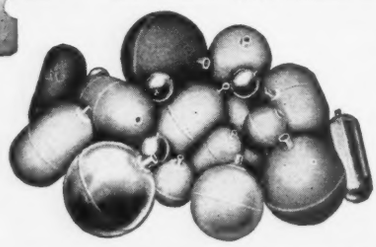
TRAPS ● FLOATS

● CONTROL VALVES



● NICHOLSON TRAPS of the industrial thermostatic type are large in capacity, will not freeze, eliminate air binding, require no adjustment, prevent dribbling, provide intermittent discharge and never water-log. In many cases they step up process production as much as 30%. Pressures from vacuum to 300 lbs. with superheat. Sizes ¼" to 2". Bronze, cast iron, cast steel construction. (Trap Bulletin No. 941)

● NICHOLSON FLOATS are available in all sizes, all shapes for all applications—always dependable! High tensile strength—great external pressure resistance. (Bulletin No. 339)

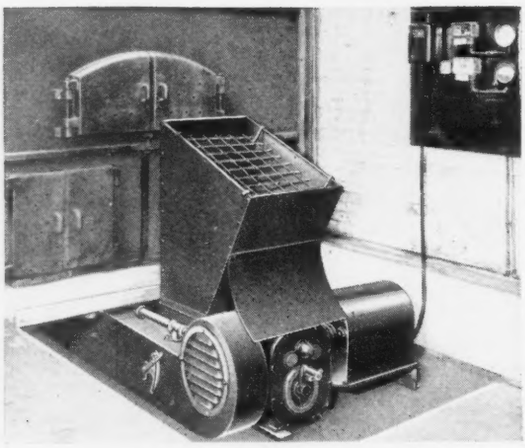


● NICHOLSON CONTROL VALVES are designed for long life, quick and dependable control of air, steam, oil, gas or water. 2, 3, or 4-way types. (Bulletin No. 140)

W. H. NICHOLSON & COMPANY
125 OREGON STREET
WILKES-BARRE PENNSYLVANIA, U.S.A.

Rely on Nicholson for: Industrial Steam Traps, Piston and Weight Operated Traps, Control Valves, Floats, Flexible Couplings, Expanding Mandrels, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

DESIGNED—not just adapted FOR HEAVY-DUTY OPERATION!



Frederick Stokers were built *first and primarily* for heavy-duty industrial applications. Consequently, every part is engineered from materials selected to withstand severe service conditions through years of use. The Frederick is exceptionally "rough-tough-and rugged".

Design is unusually simple . . . mechanically logical . . . therefore, giving you exceptional freedom from maintenance worries.

Whatever your firing problem, there's a Frederick Stoker to handle it—efficiently, economically. Usually, it has a long success record on similar jobs. Ask about it; write

The FREDERICK IRON & STEEL COMPANY, Frederick, Maryland . . . "Builders of Good Stokers for Over 24 Years."

FREDERICK Industrial STOKERS

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COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS • ASH STORAGE BINS

nection with new Lake City Ordnance Plant, for War Dept to Walbridge-Aldinger Co and Foley Bros, Inc, Independence. Est $2,000,000. Smith-Hinchman & Grylls, Inc, 800 Marquette Bldg, Detroit, Mich., archts.

N. J., East Rutherford—Pub Serv Electric & Gas Co, 80 Park Pl, Newark, awarded contract altering substation to Edward M Waldron, Inc, 40 Park Pl, Newark, $45,000.

N. J., Linden—Standard Oil Co of N. J., 500 N Broad St, Elizabeth, awarded contract constructing power house addn, Bayway Refinery, to Arthur G McKee & Co, 2300 Chester Ave, Cleveland, Ohio, over $40,000.

North Carolina, Tennessee and Alabama—Tennessee Valley Auth, Knoxville, Tenn., will construct Fontana Dam, Little Tennessee River, in North Carolina, 2 hydro projects, 1 on south fork Holston River about 7 mi southeast Bristol, Tenn., and Watauga Dam, Cardens Bluff on Watauga River, 10 mi upstream from Elizabethton, Tenn., addns to Watts Bar, Knoxville, Tenn., and Sheffield, Ala., steam plants, and 324,000 kw in addn'l generators, existing dams, by own forces. $49,000,000.

Ohio, Cleveland—General Chemical Co, 40 Rector St, New York, N. Y. awarded contract constructing power plant addn, alterations, to C Schimmelman, 1173 Sylvania Ave. Est. $40,000.

Pa., Johnstown—Bethlehem Steel Co, Locust St, awarded contract constructing power plant addns, imprvs, to Wilson Const Co, 305 Bedford St. Est. $100,000.

Tenn., Tullahoma — City, % mayor, awarded contract constructing dam, power bldgs, extend water and sewerage system, Docket, Tenn. 40-103, to J B McCrary Co, Inc, 22 Marietta St Bldg, Atlanta, Ga., and E H Marhoefer Jr & Co, 222 W No Bank St, Chicago, Ill., $409,145. Est. $400,000. Greeley & Hansen, 6 N Michigan Ave, Chicago, Ill., engrs.

Texas, Denison—U S Eng, Citizens Bank Bldg, awarded contract for two generating units for Denison Dam Project, Red River, to Westinghouse Electric & Mfg Co, Insurance Bldg, Dallas. $926,507.

Texas, Texarkana—War Dept, 20 St and Constitution Ave N W, Wash., D. C., awarded contract constructing water and steam dist and power facilities lines, steam heating and ventilating system, etc, near here, to Associated Mechanical Contractors, 2224 Summer St, Dallas, approx $380,000; two 200,000-gal elevated steel water tanks to Pittsburgh Des Moines Steel Co, 3436 Neville Island, Pittsburgh, approx. $110,000.

Tex., Winters—City, T A Smith, mayor, awarded contract constructing generating plant to Universal Electric Const Co of Alabama, Inc, Guntersville, Ala. Est about $160,000.

Washington—Bureau Reclamation, Customhouse, Denver, Colo., awarded contract furnishing three hydraulic turbines for Grand Coulee Power Plant, Columbia Basin Project, Spec 1013, to Newport News Shipbuilding & Dry Dock Co, Newport News, Va. $1,900,000.

Wash., Grand Coulee—Bureau Reclamation, Customhouse, Denver, Colo., awarded contract constructing east powerhouse, Grand Coulee Dam, to Consolidated Builders, Inc, Grand Coulee. Est. approx $4,000,000.

Wis., Genoa—Tri-State Power Co-operative, awarded general contract superstructure power plant addn, to Thornsen-Abbott Const Co, Marshfield.

Wis., Kaukauna—Kaukauna Utilities Comm, Kaukauna, H F Weckwerth, mgr, awarded contract constructing power plant addn, to Oudenhoven-Verbruggen Const Co, Kaukauna. $39,944.

NEW CATALOGS, BOOKLETS, BULLETINS

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For Your Convenience

Two business-reply cards are printed here as a part of this insert. On each is room for you to request four pieces of literature.

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1. If you are requesting four pieces or less, please use only the bottom card. Likewise, for four to eight pieces, use both attached cards.

2. Be sure to fill one of the eight spaces for each piece you order. This will assure your receiving copies of literature promptly by reducing amount of clerical work in handling your request.

3. When you have filled out one space for each catalog or bulletin you want, detach along the scored lines and drop the cards in the mail. No postage is required.

Example

Write in circle number of item describing one catalog wanted → (17)
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Address 110 WEST 70TH ST.
NEW YORK, N.Y.
Company WM. DOE MFG. CO.
Title POWER ENGINEER
POWER, 330 West 42nd St, New York 3/42

These cards not good after April 1, 1942

BOILERS AND ACCESSORIES

1 STOKERS—Iron Fireman Mfg Co, Portland, Ore. 20-page bulletin features Iron Fireman Poweram heavy-duty stokers for boilers developing up to 400 hp; outlines features of these stokers, shows actual installation photographs and lists representative users.

2 REFRACTORIES — General Refractories Co, Philadelphia, Pa. 72-page catalog lists all company refractory products available for non-ferrous and chemical industries as well as blast furnaces. Approximately half the book is devoted to tables on actual use of various types of brick, and other tables essential to refractory users.

3 BOILERS—Combustion Engineering Co, Inc, 200 Madison Ave, New York, N. Y. 16-page catalog gives details of design and construction of hrt boilers, contains various setting drawings and tables of standard dimensions for both brickset and steel-encased settings, and illustrates installations with different methods of firing. Includes typical furnace arrangements for burning bagasse.

4 PLASTIC CEMENT — Botfield Refractories Co, Swanson and Clymer Sts, Philadelphia, Pa. 6-page folder illustrates Adachrome plastic supercement for bonding and surfacing of furnaces, incinerators, ovens, kilns, etc. Also mentions other company products.

FURNACE INSPECTION DOOR—Gillette Kiln Sales Co, Pittsburgh, Pa. 4-page circular contains information on construction, operation details and installation of an inspection door which is applicable to various types of industrial furnaces, boilers and kilns under continual heats up to 2500 F.

6 WATERPROOFING MATERIALS—Primoid Products Corp, 103 Park Ave, New York, N. Y. 4-page bulletin describes various rubber-base compounds, designed to stop leaks or seepage through brick, concrete, stucco or other types of masonry. These also prevent corrosion or rusting of metals because they are oil-, alcohol-, gasoline-, and acid-resistant. Lists typical users and comments.

ELECTRICAL EQUIPMENT

7 CABLES — General Electric Co, Schenectady, N. Y. 8-page bulletin, GEA-3652 describes "GF" gas-filled cable, self-supervising for 10-kv to 40-kv service, its principles, advantages, uses, performance and accessories with charts and diagrams.

8 HIGH-VOLTAGE INDICATORS — Air Reduction Co, 60 East 42nd St, New York, N. Y. illustrated pamphlet describes Airco's complete line of high-voltage indicators, specifically designed for protection of men working on high-voltage lines. Complete construction, installation and operating details are fea-

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tured with photographs of the indicators in actual use and suggested method of mounting.

HEATING, VENTILATING & AIR CONDITIONING

9 HUMIDIFIERS—Armstrong Machine Works, 812 Maple St, Three Rivers, Mich. tells facts about humidification, describes Armstrong humidifiers with tables, diagrams, and photographs. Also furnishes hookup diagrams and recommended pipe sizes.

LUBRICATION

10 LUBRICATORS — Oil-Rite Corp, 332 W Wisconsin Ave, Milwaukee, Wis. 4-page leaflet presents constant-level lubricators for maintaining an accurate, constant and positive level of oil in ring, ball and roller bearings. Includes diagrams, features and specifications of company's lubricator line.

11 LUBRICATION — Fiske Brothers Refining Co, Newark, N. J. 12-page catalog No. 2-41 describes the company's service to machinery manufacturers that assures proper lubrication of machines in use and contains comments from typical users.

12 PURIFIERS — Honan-Crane Corp, Lebanon, Ind. 8-page catalog, No. 100 M, discusses continuous oil purifiers for gas and diesel industrial engines, having a capacity for handling lubricating oil of engines from 30- to 5000-hp. Complete details of operation and mechanical specifications are given along with illustrations of the equipment.

MATERIALS HANDLING

13 MATERIALS HANDLING — The American Pulley Co, Philadelphia, Pa. 20-page catalog, T-41 covers American pressed-steel hand trucks and wheels, as well as other materials handling equipment. Includes general utility trucks, bag trucks, warehouse trucks, railroad trucks, stevedore trucks, and special trucks.

MECHANICAL TRANSMISSION

14 BEARINGS—Johnson Bronze Co, 508 S Mill St, New Castle, Pa. 36-page catalog L-3 outlines Ledaloyl self-lubricating bronze bushings and bearings in standard stock sizes which eliminates the cost of extra tools and dies.

METERS, INSTRUMENTS & CONTROLS

15 CONTROLS—Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass. 24-page general catalog No. 41 covers company's line of automatic control equipment for pressure, temperature, rate of flow, liquid-level, etc, with descriptions, diagrams, and tables of technical data.

16 INSTRUMENTS—Meriam Co, 1955 W 112th St, Cleveland, Ohio 8-page catalog No. C-10 discusses company's line of manometers, draft gages, flowmeters, mercury-pressure gages, tank gages for measuring pressures, vacuums and flows of liquids and gases with illustrations and descriptions of equipment, suggestions for use, size ranges, dimensions, weights and list prices.

17 CONTROLS — Brown Instrument Co, Philadelphia, Pa. Bulletin No. 8301, 56 pages, describes electric, pneumatic, as well as combined electric and pneumatic controls and defines various technical terms used in descriptions. Photographs illustrate 44 industrial controls and safeguards such as temperature controllers, float switches, combustion safeguards, etc.

18 RECORDERS—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa. 28-page catalog, N-58-161, describes recording instruments for telemetering and totalizing electric-power loads and discusses the use of load recorders by isolated utility and industrial power plants as well as better-known applications in system load dispatching. Contains many photographs and diagrams.

19 CONTROLS — A. Schrader's Son, Dept P, 470 Vanderbilt Ave, Brooklyn, N. Y. catalog contains descriptions of new line of industrial products for use in the control of compressed air. Contains many photographs, diagrams, tables and charts for those interested in production as well as compressed air and control.

20 THERMOMETERS—Brown Instrument Co, Philadelphia, Pa. 32-page catalog No. 9004, covers resistance thermometers for indicating, recording and controlling temperatures to a high degree of accuracy. Pictures thermometers, singly and installed in groups. Also contains many charts and diagrams.

PIPING, VALVES AND FITTINGS

21 STEAM TRAPS — Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa. 16-page bulletin T-1736 gives complete information regarding construction features, operating principles, installation and operating suggestions, capacities, prices, weights and dimensions of Yarway traps. Typical installation pictures and customer testimonials are shown.

21A VALVES—Jenkins Bros, 80 White St, New York, N. Y. 16-page catalog covers stainless-steel valves in gate, globe-and-angle, lift-check, swing-check, and Y-valve types. Diagrams illustrate features of each valve described. Specifications also furnished.

22 VALVES—Edward Valve & Mfg Co, East Chicago, Ind. 4-page catalog No. 12-G5 describes Edward Intex valves, integral-seat valves, for leak-proof performance in extreme temperature and pressure service in power plant and process piping systems. Many photographs, tables and diagrams point out features, dimensional details, and material specifications.

23 VALVES—Edward Valve & Mfg Co Inc, East Chicago, Ind. 56-page catalog No. 12 includes complete design, dimensional and metallurgical descriptions of cast-steel stop, check, and stop-check valves. Also describes Edward patented Impactor handwheels, throttlers, bypasses, etc.

PRIME MOVERS

24 DIESEL COOLERS — Fairbanks, Morse & Co, Chicago, Ill. 16-page bulletin FECD-2 covers the complete line of Fairbanks-Morse evaporative coolers for diesel engines with photographs and diagrams. Tables of recommended sizes for diesel and gas engines, water-cooling capacity, dimensional drawings and piping diagrams are also included.

PUMPS

25 PUMPS—Lawrence Machine and Pump Corp, 371 Market St, Lawrence, Mass. 4-page folder discusses non-

(*Continued on page* 166)

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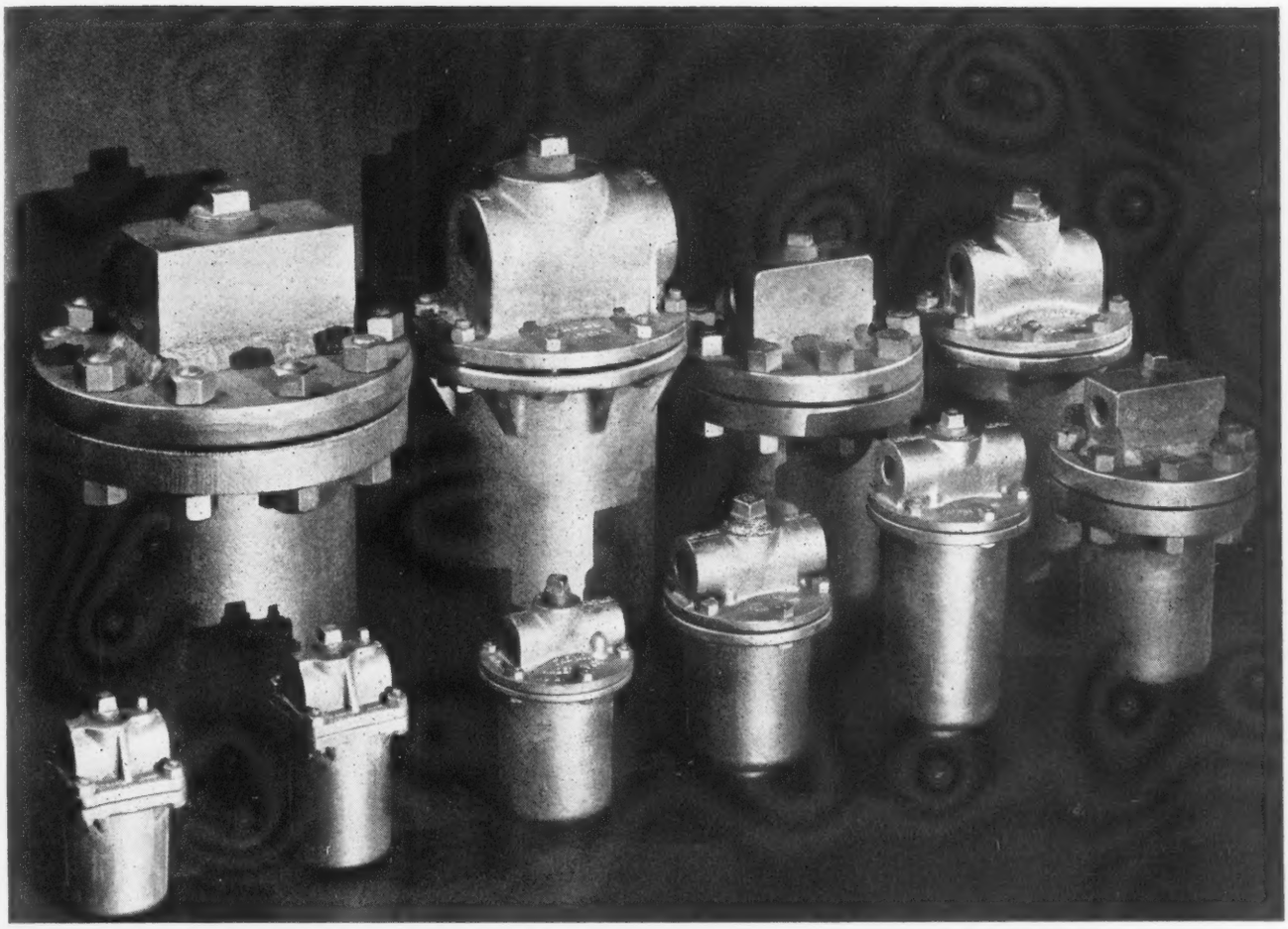


CONNECT any size SUPER-SILVERTOP AS AN ELBOW OR STRAIGHT-IN-LINE

All sizes of Anderson Super-Silvertop steam traps can be connected not only straight-in-line but also as an elbow. Regardless of the trap size needed, you can get a straight-in-line connection. Then if you change your mind you can use that same trap as an elbow connection.

This optional connection is only available with guided bucket Super-Silvertops. And this low cost ease of installation (no extra fittings to buy and install) is matched by the ease of inspection. These up-to-date inverted bucket steam traps are inspected right on the line without disturbing pipe connections.

Other good reasons for choosing Super-Silvertop traps are the extra capacity that comes from the longer bucket lever (that opens a larger valve) and the service record of long life and trouble-free operation. This record is a result of 55 years of steam trap manufacturing experience.

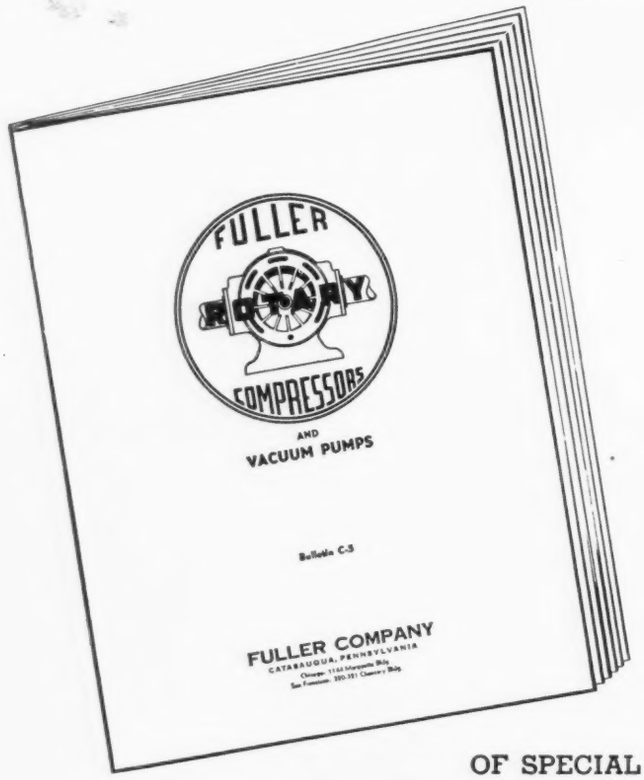
Let that experience and service record help you in your job—let Anderson traps save you trouble, time and money by using Super-Silvertop on every installation. Have you a copy of the useful book — "How To Choose a Steam Trap?" Then why not write for your free copy?

THE V. D. ANDERSON CO.
1934 West 96th Street • Cleveland, Ohio

Super-Silvertop STEAM TRAPS

FULLER ROTARY COMPRESSORS
AND
VACUUM PUMPS

ARE DESCRIBED
IN THIS NEW BULLETIN



OF SPECIAL INTEREST TO
SUPERINTENDENTS AND MAINTENANCE
MEN LOOKING FOR LOW-COST OPERATION

If you are interested in compressed air or gases, capacities to 1800 C.F.M. actual free-air delivery, pressures to 125-lb.—vacuums to 29.90-in., (referred to 30-in. barometer), you should investigate these highly efficient machines. This new bulletin illustrates and describes these units . . . send for your copy today . . . just fill in the coupon.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1144 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

C-66

FULLER COMPANY
Catasauqua, Pa.
Please send me a copy of Bulletin C-5.
Name..... Title.....
Company .....
Address .....
City..... State.....

New Bulletins

(*Continued from page* 164)

clogging sewage and sludge pumps and their application in handling of sludge in industrial and chemical plants where it is necessary to pump liquids containing various solid and fibrous material in suspension. Also contains photographs and cross-sectional diagrams.

26 PUMPS — Downingtown Mfg. Co, Huber Pump Div, Downingtown, Pa. 6-page folder introduces pump operating on what the company calls the "squeegee" principle, and illustrates it with many photographs and diagrams.

WATER TREATMENT

27 WATER TREATMENT — Graver Tank & Mfg Co Inc, East Chicago, Ind. 12-page bulletin covers six methods of softening water with Graver zeolites. Also includes general information as well as practical applications of these water-treatment methods.

28 WATER TREATMENT — American K A T Corp, 122 East 42nd St, New York, N. Y. 4-page issue of new house organ to be published periodically. This bulletin is said to carry the latest data, technical and current, pertaining to the use of company's water treatment for boilers, stills and evaporators.

29 WATER TREATMENT — Water Treatment Co of America, 1159 Hodgkiss St, N S, Pittsburgh, Pa. 8-page booklet explains in semi-technical style the functions of "Baerite" formulas in balancing waters which cause rust, scale, corrosion, foaming, priming and other boiler troubles.

30 WATER TREATMENT—American Water Softener Co, Lehigh Ave and Fourth St, Philadelphia, Pa. 8-page bulletin describes two common processes for softening water, i e, base exchange, and lime and soda. Also includes actual installation photographs as well as typical cross-section of company's water softener.

31 WATER TREATMENT—Permutit Co, 330 West 42nd St, New York, N. Y. 12-page bulletin No. 2420 describes proportioning and non-proportioning devices to feeders of phosphate, sodium sulphite, sodium sulphate, and other supplementary chemicals to boilers.

WELDING

32 WELDING—Arcos Corp, 401 N Broad St, Philadelphia, Pa. Bulletin No. 5 contains tables showing current values, weld-metal characteristics, deposition data, heat treatment and applications of Arcos stainless and alloy electrodes.

33 WELDING—Lincoln Electric Co, Cleveland Ohio Bulletin 412 discusses the Lincoln "Shield-Arc", the welder with self-indicating dual continuous control for lower welding costs, wider welding range, and simplified operation. Many photographs illustrate the features of these arc welders.

33A WELDING ELECTRODES — Hobart Brothers Co, Box P-79, Troy, Ohio, revised 20-page handbook describes welding electrodes and accessories.

OTHER EQUIPMENT

34 FIRE-EXTINGUISHING EQUIPMENT—Cardox Corp, Room 1715, 307 N Michigan Ave, Chicago, Ill. 9-page pamphlet describes results of four demonstrations showing effectiveness of fire-extinguishing methods developed by Cardox. Bulk, low temperature, low-pressure, liquid CO_2 used in these tests was shown to be effective in extinguishing large pool fires, and outdoor transformer compartment fires. Many photographs show steps, equipment and results.

35 TOOLS—Studebaker Machine Co, 9 South Clinton St, Chicago, Ill. 6-page folder lists variety of mountings, construction, and features of a hydraulic

Right at Your FINGERTIPS

Turn to Sweet's Catalog File

—the Mason-Neilan section—when you want information on automatic control equipment and want it in a hurry. Look under "Controls and Regulators" in the Process Industries, Engineering, or Power Files.

Mason-Neilan offers you the widest selection of equipment for automatic control: Pressure regulators; recording, indicating, controlling instruments; liquid level controllers of all types; control valves.

Look first in the Mason-Neilan Catalog. Chances are that you will find exactly what you need.

FREE CONTROL CATALOG

If you don't have Sweet's, we will gladly send you a handy reprint of our section. 24 pages of automatic control equipment for pressure, temperature, liquid level, and flow.

MASONEILAN

Ask for Catalog 41

MASON-NEILAN REGULATOR CO.

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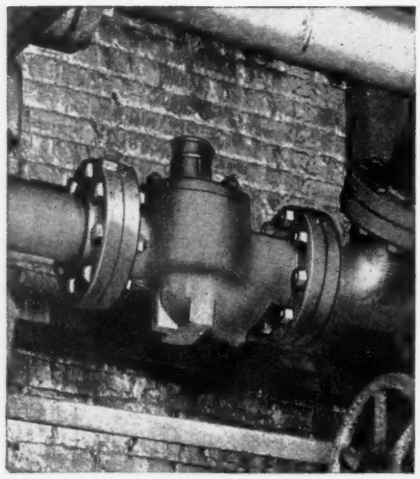
NEW YORK BUFFALO PHILADELPHIA PITTSBURGH TULSA TOLEDO
CHICAGO ATLANTA ST. LOUIS HOUSTON LOS ANGELES SAN FRANCISCO
MASON REGULATOR CO. OF CANADA, LTD., MONTREAL, CANADA



HENSZEY
FEED WATER
METERS

. . . on the job to help the nation's condenseries produce more evaporated milk!

Increased demands for evaporated milk for home and export consumption have put a new strain on all the equipment needed for that job. There are 125 installations of Henszey Meters in five of the leading milk evaporating plants. The rugged construction and exclusive operating features of these meters enable them to stand up under this terrific strain.

Your contribution to the war effort may be different, but if you are dependent upon the measuring of boiler blowdown, boiler feed water, free running chemicals, condensate or other similar hard-to-measure liquids—Henszey Meters are the answer!

Check these Features

- They are placed right in the line.
- They accurately, and continuously, measure the pulsating discharge of reciprocating pumps.
- All moving parts subject to wear are easily replaced.
- The entire mechanism can be removed from the meter without removing the body of the meter from the line.
- The operation of the meter is not dependent upon close clearances at any point.
- Meters can be calibrated to read in Gallons, Pounds, or Cubic Feet, at any specified temperature.
- Sizes: 10 to 600 G.P.M. cold water, steady flow rating. Connections: ¾" to 4". Special sizes to order.

Send for complete information stating your problem if possible. No charge for recommendations or suggestions.

HENSZEY COMPANY
Dept. D2 Watertown, Wis.

HENSZEY

vicepress for production, tool room, and maintenance work. Also contains many photographs of these vicepresses which are said to speed up vise work, cutting, testing, stamping, riveting, assembling, etc.

36 Catasauqua, Pa. 16-page booklet COMPRESSORS — Fuller Co, describes Fuller rotary compressors and vacuum pumps. Many line diagrams, cross sections, photographs of the machines, typical installations and numerous tables are contained.

37 CERAMICS—American Lava Corp, Chattanooga, Tenn. 12-page reprint from Electronic Engineering is entitled "The Electrical Properties of High-Frequency Ceramics". Many charts, photographs and diagrams contain data not hitherto pubished.

38 WRENCHES—Blackhawk Mfg Co, Ind. Supply Div, Milwaukee, Wis. 48-page pocket-size booklet describes socket, box-type, specialty and torque-indicating wrenches, their uses and new features.

39 WHITEPRINT MACHINES—Ozalid Products Div, General Aniline & Film Corp, Johnson City, N. Y. 4-page folder announces new Ozalid model "B" whiteprint machine. Describes mechanical features and specifications of Ozalid process.

40 STEEL SHAPES — Commercial Shearing and Stamping Co, Youngstown, Ohio 16-page bulletin, Section No. 3, lists a number of standard steel shapes which can be purchased as production items, without tool or die charges. Also includes dimensions and drawings of the shapes described.

41 LATHES—South Bend Lathe Works, South Bend, Ind. 8-page bulletin No. 52 includes illustrations, basic dimensions, capacities, speeds and feeds of back-geared screw-cutting lathes, as well as attachments for tool-room and production work.

42 TOOLS—Black & Decker Mfg Co, Towson, Md. 56-page data book traces screw-thread principle from Archimedes to present day with special emphasis on company's work in field of power assembly tools, including portable electric screw drivers, nut runners and tappers.

43 FLOOR COATING — Flexrock Co, 2377-B Manning St, Philadelphia, Pa. literature describes Colorflex Plus, dust-proof floor preservative that imparts a dye-like coloring which uses the floor itself for wear resistance. Is said not to peel or crack, good for interior or exterior use over wood or concrete.

44 VIBRATING SCREENS — Robins Conveying Belt Co, Passaic, N. J. Bulletin No. 118 presents style "M" Vibrex screen which handles stone, gravel, sand, coal, and other bulk materials. Folder states that the new machine saves users money on installation, power, lubrication, screen cloth and maintenance.

45 HEATERS, FANS—B F Sturtevant Co, Hyde Park, Boston, Mass. Bulletin No. 456, spiral-bound, 24 pages, gives the range of company's work in the power apparatus field throughout this country and abroad by reproducing a series of advertisements describing typical installations made by Sturtevant. List of products includes air-conditioning equipment, suspended speed heaters, centrifugal fans, air washers, etc.

46 TURRET LATHE — South Bend Lathe Works, Dept 5P, South Bend, Ind. 4-page condensed catalog illustrates and describes South Bend No. 2-H Turret Lathe with complete specifications and construction features. New lathe is adaptable to long run or small lot production on wide range of bar, chucking or fixture jobs. Has capacity of 1¾ in. through the spindle hole, 16 in. swing over the bed and saddle and 1 in. through the collet.

47 TOURNACRANE—R G LeTourneau Inc, Peoria, Ill. 4-page bulletin features Tournacrane, a high-speed lifting tool for construction and industrial use. Booklet shows numerous applications around factory yards, industrial plants, building construction and earth work.

48 ELECTRIC HEATING UNITS — Westinghouse Electric & Mfg Co, Dept 7-N-20, East Pittsburgh, Pa. 40-page catalog 28-000 describes electric heating units and controls for industrial application involving the heating of liquids, solids or air.

When you need grates

Specify BATES

FOR LONG-TIME ECONOMY

FILLET WELD

BATESGRATES

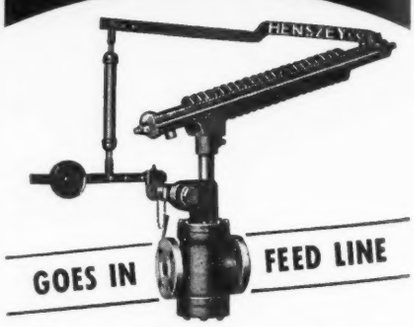
—One Piece Construction

Each intersection ,and consequently, each complete panel of Batesgrates, is strictly one piece. Non-slip, sharp top edge, self cleaning cross bars like the ridge of a roof. No cracks, joints, or acute angles. No grooves to hold grease and dirt and create slippery spots. Batesgrates are an engineered assembly of bars — all bars work.

Write for engineering Catalog No. 937.

WALTER BATES COMPANY
208 S. LaSalle St. Chicago, Ill.

HENSZEY
BOILER FEED REGULATORS



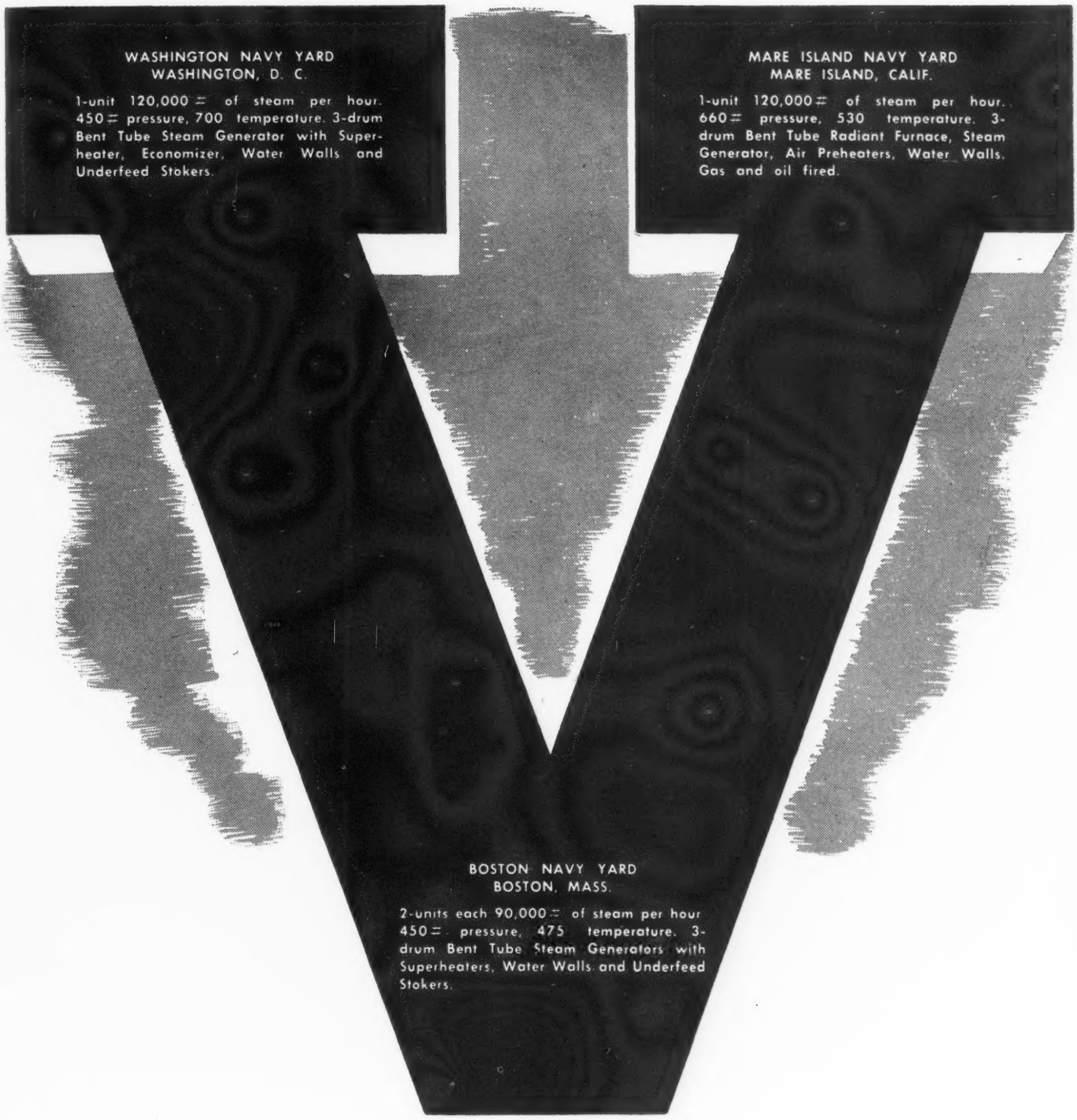
GOES IN FEED LINE

The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order—nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. D2—Watertown, Wis.


WASHINGTON NAVY YARD
WASHINGTON, D. C.
1-unit 120,000 # of steam per hour. 450 # pressure, 700 temperature. 3-drum Bent Tube Steam Generator with Superheater, Economizer, Water Walls and Underfeed Stokers.
MARE ISLAND NAVY YARD
MARE ISLAND, CALIF.
1-unit 120,000 # of steam per hour. 660 # pressure, 530 temperature. 3-drum Bent Tube Radiant Furnace, Steam Generator, Air Preheaters, Water Walls. Gas and oil fired.
BOSTON NAVY YARD
BOSTON, MASS.
2-units each 90,000 # of steam per hour 450 # pressure, 475 temperature. 3-drum Bent Tube Steam Generators with Superheaters, Water Walls and Underfeed Stokers.

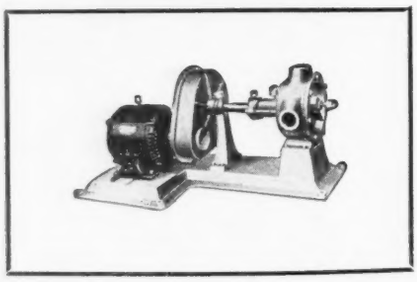
The contract for each of these installations calls for the furnishing of equipment, complete erection and putting into operation by EDGE MOOR.

EDGE MOOR IRON WORKS, INC. 30 Rockefeller Plaza, New York, N. Y.

Kansas City Chicago Detroit Richmond, Va.

In Canada UNITED STEEL CORPORATION, LTD. Toronto Montreal

NO PRIORITIES ON THE CORRECT ANSWER TO PUMPING PROBLEMS



Under present conditions, with priorities in effect on all types of machinery, the correct answer to your pumping problem is doubly important. You can't afford to gamble. Today, more than ever before, pumps must DELIVER. So industry depends on Viking Rotary Pumps because of their long record of rugged, trouble-free performance.

If you have a pumping problem, tell us about it. We'll do our best to help you. Our Viking installation and maintenance booklet free on request.

Figure 12, shown above, is pump back-geared to motor. Cast iron gears and non-metallic pinion. Available in 5, 10, 20, 35, 50 and 90 GPM sizes. Viking relief Valve on Pump Head at slight extra cost. Complete information in Bulletin 802-35. Write for it.

VIKING
PUMP COMPANY
CEDAR FALLS, IOWA

Power Lines

(*Continued from page* 124)

deferred because they have dependents, those who are above the ages liable for military service—45 to 65—and in many cases among the women of this country.

"Employers must be honest and sincere in their requests for deferments and must limit such requests to cases of men who are in fact necessary. No industry or activity, no matter how closely identified with national production of war, can ever become a refuge for those who seek to avoid their obligation to their country in its hour of need."

OBITUARIES

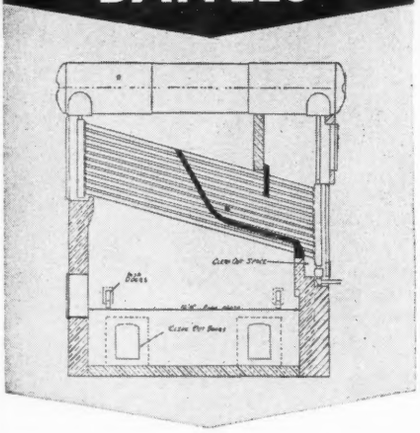
A B Lawrence, 62, associated with the General Electric Co for 41 years, and active in the switchgear field since 1902, died Dec 8, 1941. Mr Lawrence was graduated from Union College in 1900 and immediately entered General Electric. For the past seven years he had been acting as supervisor of sales promotion and commercial engineering in the switchgear division at Philadelphia.

Joseph Engasser, a member of the National Association of Power Engineers, died Dec 24, 1941, at New Haven, Conn. Mr Engasser was also a chairman of the Board of Examiners of Engineers, a member of the National Association of Practical Refrigerating Engineers, and other societies.

Dr Frank Conrad, 67, assistant chief engineer of the Westinghouse Electric & Mfg Co, died Dec 10, 1941. Dr Conrad joined Westinghouse in 1890. His experiments led to the establishment of Station KOKA, pioneer broadcasting station. During the first World War he

Frank Conrad

ANY type of boiler will deliver MORE POWER at LESS COST with Enco Streamlined BAFFLES

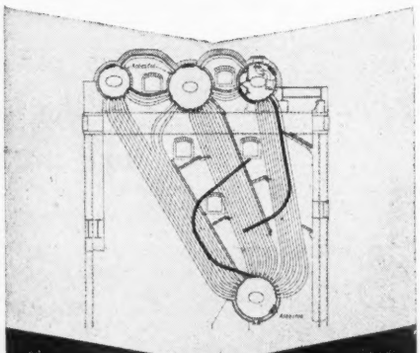


THE cross-flow principle of Enco Streamlined Baffles with its higher efficiencies, may be applied to any type of boiler—horizontal or vertical, straight or bent tube.

By streamlining and curving, gas passages are tapered to maintain velocity as the gas volume is reduced, resulting in a higher rate of heat transfer to boiler and superheater surfaces, and lower flue gas temperatures.

Enco Streamlined Baffles reduce draft loss by eliminating eddy currents, bottlenecks and dead gas pockets—save steam because soot blowers work less often and more effectively.

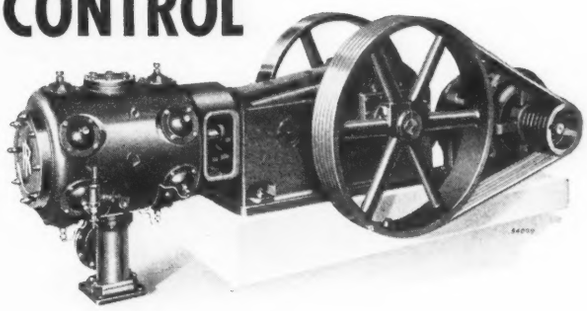
Ask for Bulletin BW-40 containing valuable engineering data on modern baffle wall construction—It's free.

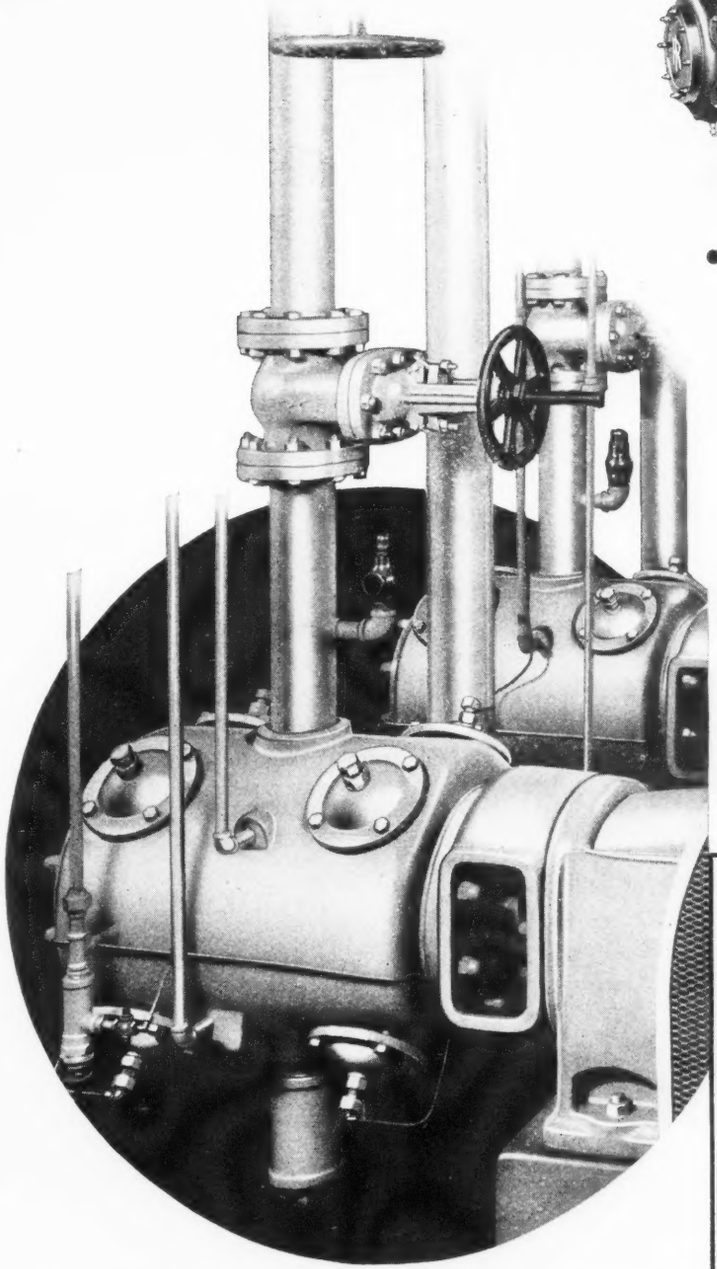


THE ENGINEER CO.
Enco 75 West St. New York, N.Y.

OIL-FREE AIR

for BOILER INSTRUMENT CONTROL





- THE NECESSITY of oil-free air for instrument control has opened a new field for Ingersoll-Rand NL Compressors. These units have non-lubricated cylinders of patented design. The use of special carbon wearing and piston rings dispenses with the need for any liquid or grease lubricants.

Boiler instrument control is an outstanding example, for the use of NL Compressors in power plants has insured more accurate operation, freedom from sticking and reduced maintenance throughout the entire control system.

- *I-R PRODUCTS: Condensers, Pumps, Steam Jets, Refrigerating Units, Compressors, Blowers, Rock Drills, Pneumatic Tools.*

ES COMPRESSORS

Heavy-Duty, Single-Stage
Air or Gas

•

5 to 125 hp sizes
Any Type of Drive

Belt, Direct-Connected,
or Built-In Steam

Write today for additional information on these compressors. A call to the nearest I-R branch office will bring an I-R representative well qualified to help with your problems.

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MAXIMS
REDUCE HIGH VELOCITY STEAM ROAR

At the Lihue Plantation Co. mill in the Hawaiian Islands this battery of five connected Maxim Silencers with a total capacity of 135,000 lbs. per hour has been installed on a high velocity steam exhaust . . . reducing the roar to a whisper . . . and protecting, by means of safety valves against shock to the system caused by sudden shutdown of the mill.

The silencers are connected in parallel and operate progressively as the steam pressure builds up to capacity.

Both these Silencers and a similar set installed on an adjacent mill require no maintenance. There are no external parts to require inspection or replacement. Paint is the only protection needed.

Maxim will gladly supply engineering information relative to Silencers for internal combustion engine exhausts and intakes, compressor and blower intakes, steam discharges, etc. Write today to The Maxim Silencer Company, 92 Homestead Ave., Hartford, Conn.

MAXIM SILENCERS

devised special airplane radio apparatus and improved existing hand-grenade designs. Dr Conrad obtained more than 200 patents in radio and electricity during his 51 years with the company and received many honorary degrees and medals for his scientific achievements.

ROBERT S HALE, 72, formerly connected with the Steam Users Association and Mutual Boiler Insurance Co, Boston, and for many years superintendent of the special research dept of the Boston Edison Co, died at Westwood, Mass., Jan. 2. He retired from active service in 1931. He was the founder of the New England System Operators Club and the Electric Lines Club of New England.

PERSONALS

RAYMOND W KELLER has resigned his position as assistant to works manager of the East Springfield plant of the Westinghouse Electric & Mfg Co, to be-

Raymond Keller

come vice-president and assistant general manager of the Milton Bradley Co at Springfield, Mass. Mr Keller was assistant works manager since Dec 1938.

R A BARR has been appointed district sales manager in the Chicago territory of the Carborundum Co, Perth Amboy, N. J. Mr Barr formerly represented the company in the Cleveland district and recently has been sales manager of the division.

ARCH S CAMPBELL has been made manager of sales of the Superior Engine Division, National Supply Co. Previous to his appointment, Mr Campbell was branch manager at Tulsa, Okla., for the Waukesha Motor Co. Mr Campbell has been affiliated with the oil industry for the past 22 years in the mid-continent area.

DR JOHN BOSWELL WHITEHEAD has been awarded the Edison Medal for

TIME SAVED ON POWER PLANT MAINTENANCE JOBS *Helps National Defense*

For Example:

DE-SCALING DIESELS SAFELY

To prevent your Diesels from running too hot . . . to keep them delivering the maximum power output so desperately needed for war production . . . take advantage of the successful, easy Oakite method for SAFELY, quickly de-scaling Diesel cooling systems used by so many power plant engineers and superintendents.

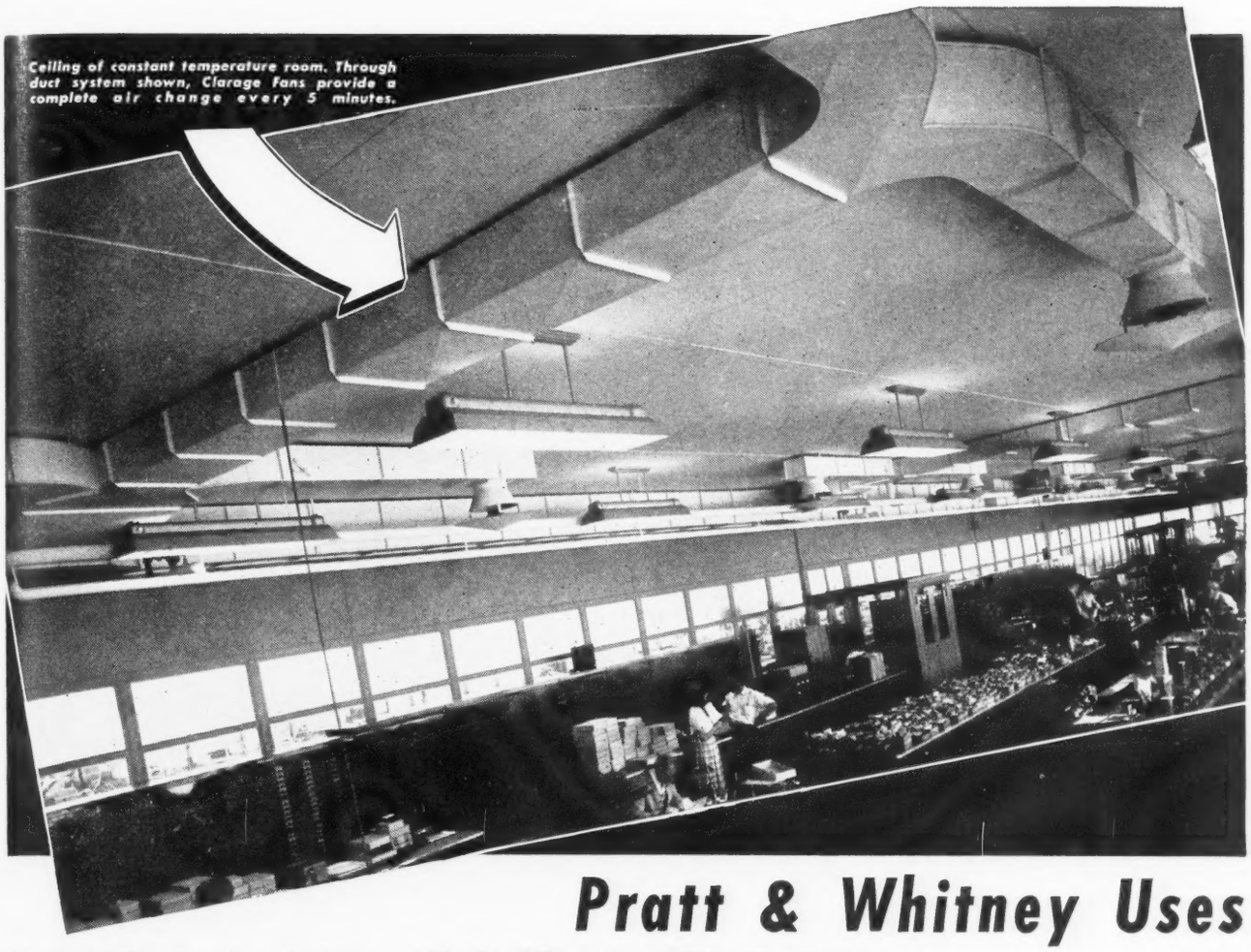
No dismantling required. Simply circulate solution of Oakite Compound No. 32 through radiators and water jackets or let "soak" for short period as directed. You'll be pleased to see how thoroughly and safely insulating lime-scale deposits are removed . . . how quickly normal cooling efficiency is restored. And cost is low!

***Do All Your* MAINTENANCE CLEANING the Faster, Safer Oakite Way**

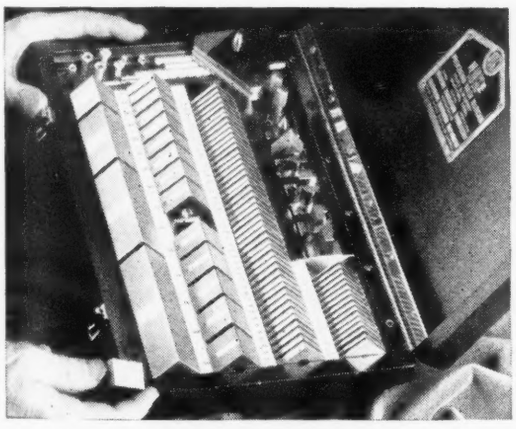
New 24-page booklet gives details . . . contains data on safely de-scaling surface condensers, heat exchangers, "lube" oil and jacket-water coolers, water-cooled compressors, etc. Write for your FREE copy TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE *Specialized cleaning*
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT


Ceiling of constant temperature room. Through duct system shown, Clarage Fans provide a complete air change every 5 minutes.

Pratt & Whitney Uses CLARAGE EQUIPMENT in World's Largest Constant Temperature Room



GUARANTEED ACCURACY ***WITHIN A FEW MILLIONTHS OF AN INCH*** — probably the most accurately made pieces of steel in the world is the set of Pratt & Whitney Hoke Precision Gage Blocks shown above, one item in a long list of P&W products for precision measuring now used in speeding war production.

Here at P&W, as in hundreds of other vital plants, Clarage is playing its part in World War Two as it did in World War One.

Gages made by Pratt & Whitney (Division Niles-Bement-Pond Co.), West Hartford, Conn., are finished to final size under constant temperature conditions. *This insures extreme accuracy of product.*

The constant temperature room, where finishing operations are handled, is the largest of its kind in the world — 40 x 400 ft. In this room, 24 hours per day, regardless of outside weather, the temperature *never* drops as low as 67°; *never* reaches 69° — relative humidity always 50%.

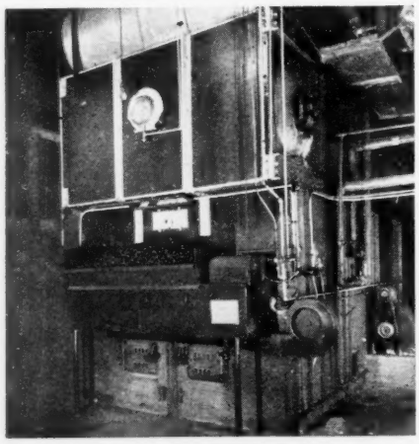
Clarage Fans and Air Washers, along with compressor equipment, are used exclusively for this exacting job — engineering and installation made by Automatic Refrigerating Company, Hartford, Conn.

If you are engaged in vital war production and have any type of air handling or conditioning problem, it will pay you to get in touch with us — *for Clarage builds the kind of equipment that makes good every time!*

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

CLARAGE FAN COMPANY—KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

For Plants that Need
MORE POWER in a Hurry!



INDUSTRIAL PLANTS working on defense contracts, or otherwise able to obtain priority ratings, can get a quick, efficient solution for many of their power and steam shortage problems by writing or wiring American Coal Burner Co. *immediately.*

QUICK DELIVERY. Standardized construction features permit quick delivery of AMERICAN FYR-FEEDER spreader stokers to meet the requirements of virtually any size boiler plant, old or new.

HIGH OVERLOAD CAPACITY. FYR-FEEDER installations invariably provide ample excess capacity to enable plants to handle new peak loads.

MORE EFFICIENT USE OF METAL. There is no "dead weight" in a FYR-FEEDER stoker! Units are simple, compact, and require a minimum of special fittings, materials, etc.

CONSERVE FUEL. FYR-FEEDER stokers burn coal, wet or dry, with high efficiency. Hundreds of AMERICAN FYR-FEEDER units now in service are producing a high return on their investment. For details, write AMERICAN COAL BURNER CO., 23-18 East Erie St., Chicago, Ill.

You Can See the Superiority
AIR FROM NOZZLES
① SPREADS COAL
② PROVIDES AIR FOR COMBUSTION
③ CREATES TURBULENCE IN COMBUSTION CHAMBER
TWO FIRES: FINES BURN IN SUSPENSION. LARGER COAL ON GRATE
MULTIPLE SCREW FEEDERS 12" APART
COAL
AIR IN TO INDIVIDUAL BURNERS
UNDER GRATE AIR

Each FYR-FEEDER has 2, or 4, or more spreader burners.

AMERICAN FYR-FEEDER
SPREADER-STOKERS

AMERICAN COAL BURNER CO., *Engineers,*
23—18 East Erie St., Chicago, Ill.

☐ YES, I want to know what the FYR-FEEDER can do in our plant.

☐ Please mail descriptive literature.

Name .....

Company .....

Address .....

1941 by the American Institute of Electrical Engineers, "for his contributions to the field of electrical engineering, his pioneering and development in the field of dielectric research, and his achievements in the advancement of engineering education." The medal was presented to Dr Whitehead during the winter convention of the Institute which was held in New York in January.

JAMES B HAYDEN was elected vice-president in charge of sales of the Industrial Brownhoist Corp, Bay City, Mich.

JAMES E. HOLMES has been made assistant manager of tubular sales of the Youngstown Sheet & Tube Co, Youngstown, Ohio. Mr Holmes was formerly associated in various capacities with the Republic Steel Corp, in Cleveland, Ohio.

WALTER GEIST, vice-president of the Allis-Chalmers Manufacturing Co, was elected a director of York Ice Machinery Corp, at a meeting of the Board of Directors held in December, 1941. Mr Geist has been vice-president of Allis-Chalmers since 1939.

G J NICASTRO has recently been transferred to the New York district sales office of Combustion Engineering Co. Mr Nicastro joined the company in 1934 and has served in various capacities in the proposition and controller departments. He is president of the New York Chapter, Society of Professional Engineers, and secretary of the Executive Committee of the ASME Metropolitan Section.

DWIGHT A BESSMER has been appointed assistant director of purchases of the Timken Roller Bearing Co, Canton, Ohio. Mr Bessmer joined Timken shortly after his graduation from the Michigan School of Mines in 1929. After completing his special engineering training course, he served as automotive sales engineer in the Detroit territory for six years. Prior to his appointment as assistant director of purchases, he entered the purchasing department as a buyer.

GEORGE P PASSMORE has been appointed works manager in charge of the Wellsville works of the Worthington Pump & Machinery Corp. Mr Passmore, until recently, has been manager of manufacturing at the South Philadelphia works of the Westinghouse Electric & Mfg Co, having been connected with the Westinghouse organization for 20 years.

PALMETTO PETE *says*

FREE WORKING SAMPLE

Try a *successful* packing at our expense! Just send us your name, address and specify service conditions and size of packing.

PALMETTO* *means "success" in packing*

Palmetto Packing is successful because it will not cut or score. It has lubricant to spare . . . stays soft and pliable. Use Palmetto to replace poor packings in your pumps and valves on steam and hot water service and you will be sure of successful results.

Reg. U. S. Pat. Off.

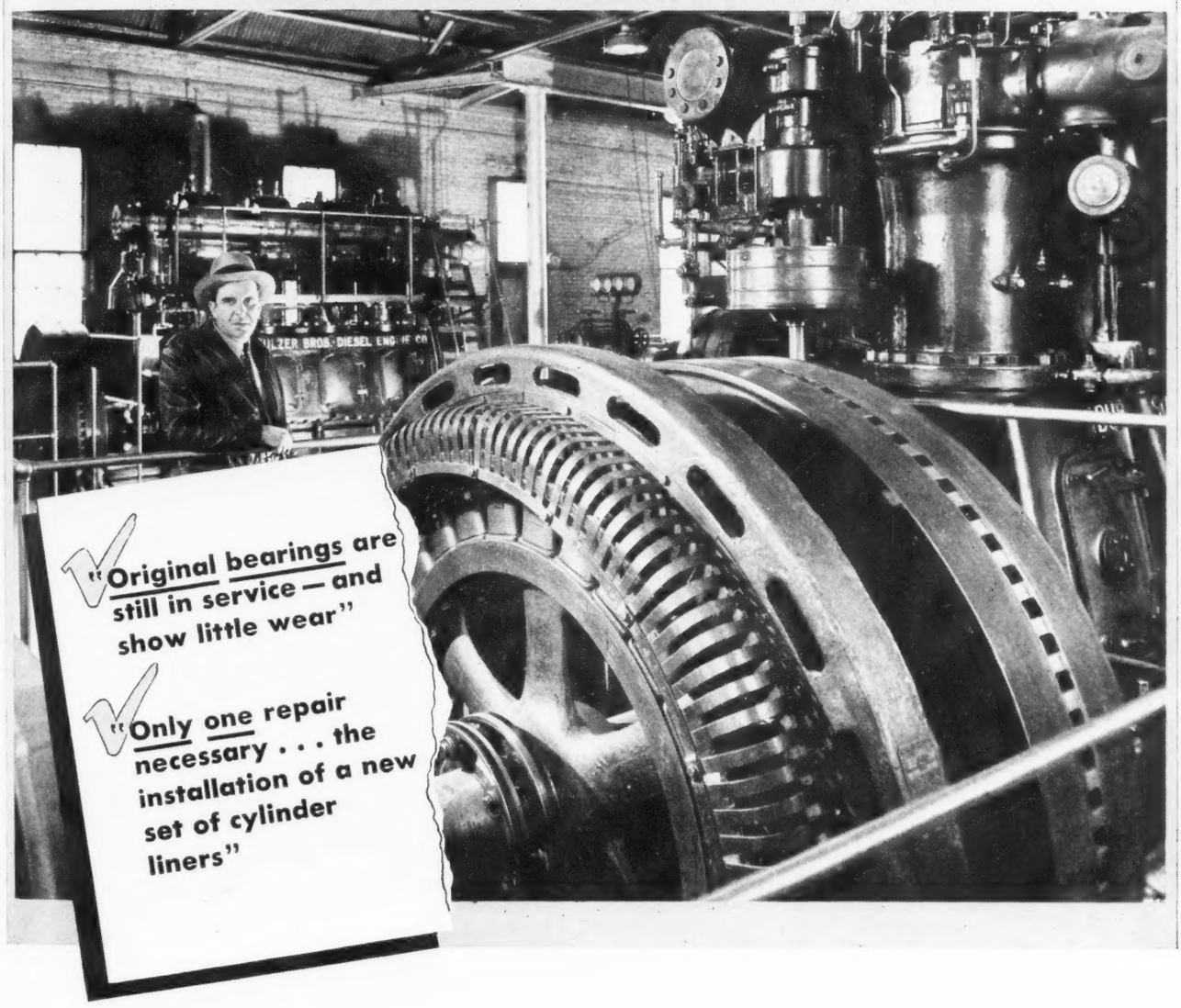
GREENE, TWEED & COMPANY
Bronx Blvd. at 238th Street
New York N. Y.

PALMETTO
for steam, hot water, air.
PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT
PACKINGS

9 out of 10 who try them, buy them

"With Gulf Parvis Oils we've set a 20 YEAR maintenance record that's hard to beat"

. . . Says this Diesel power plant Superintendent


"Original bearings are still in service — and show little wear"
"Only one repair necessary . . . the installation of a new set of cylinder liners"

"ONE liner change, no other repairs in *20 years* of 16-hour a-day service—that's the hard-to-beat maintenance record we've set with Gulf Parvis Oils," says the superintendent of the municipal Diesel power plant, city of Opelousas, Louisiana. "Along with the savings in maintenance costs, we've secured highly efficient Diesel performance by using these quality lubricating oils."

There are good reasons for a record like this with Gulf Parvis Oils in service: These oils are scientifically manufactured to provide efficient lubrication for Diesel engines. They retain their lubricating value for long periods of time even under severe operating conditions, provide positive protection at a low consumption rate, and contribute to full compression and maximum kilowatt hour performance!

Perhaps savings in maintenance costs and improved operating efficiency can be obtained in *your* Diesel plant. Investigate — ask a Gulf engineer to recommend the right grade of Gulf Parvis Oil to fit your requirements. The results will show up in your records. Gulf Parvis Oils—and the 400 other quality lubricants in the Gulf line—are quickly available to you from more than 1200 warehouses in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY · GULF BUILDING, PITTSBURGH, PA.

"STANDCO" PILLOW BLOCKS

Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.

"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Fig. 32

Write for Bulletin

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

Boston, Detroit, Indianapolis — Box 577 — Chicago, St. Louis, San Francisco

A DRUM FULL OF SAVINGS

ADAMANT FIRE BRICK CEMENT

It's the cement that makes the joints as strong as the brick they bond! Impartial laboratory tests show Adamant to have a bonding strength of 800 lbs. per sq. in. at room temperature . . . 1270 lbs. per sq. in. at 2600°F. To you, this insures maximum life of furnace walls . . . savings in time, labor and materials.

Let Adamant economize for you too!

For details, write—

BOTFIELD REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

A H SWEETNAM, formerly superintendent of the electrical engineering department, Boston Edison Co, and now New England representative of the C M Hall Lamp Co, Detroit, Mich., has also become a representative of the Fred H Schaub Engineering Co, Chicago, Ill., and the W K Mitchell & Co, Philadelphia, Pa. He has established headquarters at 256 Dorset Road, Waban, Mass.

FRANK H BOYD, for 30 years divisional manager, Cleveland territory, American Seating Co, has been appointed sales manager of the S G Frantz Co, New York, N. Y.

RALPH H DEIHL has been appointed advertising manager of the Falk Corp, Milwaukee, Wis. Mr. Deihl joined the Falk Corp in May, 1940, prior to which he spent some time in the advertising department of the Bucyrus-Erie Co, and National Enameling & Stamping Co, both in Milwaukee.

W C BUCHANAN, a director and member of the executive committee of the Allis-Chalmers Manufacturing Co, has been elected president of that company. He succeeds Max W Babb, who was made chairman of the board. Mr Buchanan has for the past six years devoted a substantial portion of his time to the Globe Steel Tubes Co. in Milwaukee, of which he is president, and in which capacity he will continue. Mr Buchanan first worked for the Cambria Steel Co at Johnstown in 1904, and by 1912 was in charge of a number of the company's rolling mills and finishing departments. When W H Donner bought the New York Steel Co, Buffalo, N. Y., which later became the Donner Steel Co, Buchanan was engaged to assist in the rehabilitation of this plant. Then followed a series of important jobs with the American Tube & Stamping Co, Bethlehem Steel Co, and Trumbull Steel of Warren, Ohio. In the early part of 1929 he joined the Keystone Steel & Wire Co of Peoria, Ill., and was vice-president and general manager of that concern when he resigned in 1935 to accept the presidency of the Globe Steel Tubes Co in Milwaukee.

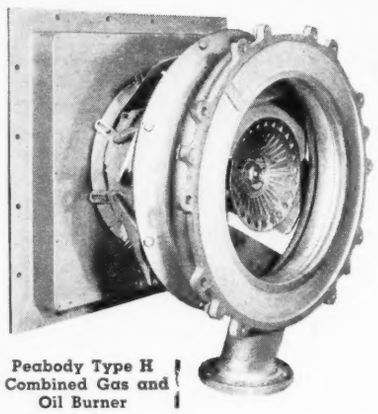
COMMISSIONER BASIL MANLY has been elected vice-chairman of the Federal Power Commission for the coming year. Mr Manly succeeds Claude L Draper, who has held the office of vice-chairman for the past two years. Commissioner Manly has been a member of the Commission since 1933, and was previously vice-chairman from 1933 to 1936. In 1938 he was appointed by President Roosevelt as vice-chairman of the National Defense Power Committee.

PEABODY COMBINED BURNERS

PROVIDE UTMOST

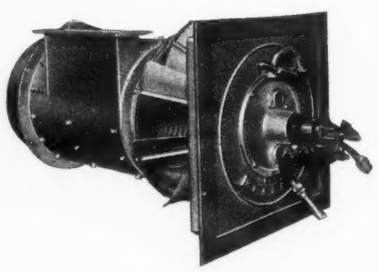
Flexibility

IN USE OF FUELS



Peabody Type H Combined Gas and Oil Burner

If you want insurance against the failure of your supply of fuel or fluctuations in its price, install PEABODY COMBINED UNITS for oil, gas and pulverized coal, or any combination of these. You will then be able to change from one fuel to the other as rapidly as the auxiliary equipment can be placed in service, burning two fuels simultaneously while changing from one to another.



Peabody Type H Combined Coal and Oil Burner

There is a PEABODY BURNER that will serve your need whatever it may be. Peabody engineers are specialists in combustion. Let them analyze your fuel burning requirements.

PEABODY ENGINEERING CORPORATION

580 Fifth Ave., New York

Offices in Principal Cities

10 REASONS why you can bank on FAIRBANKS

YOUR LOCAL FAIRBANKS VALVE DISTRIBUTOR IS READY TO SERVE YOU

Fairbanks has chosen its distributors carefully in order that users of Fairbanks Valves may be assured the best possible service at all times. These leading and representative easy-to-reach supply houses, by the very nature of their set-up, are industrially minded, appreciate the importance of selecting the right valves for different services and can be depended on to render every possible assistance promptly.

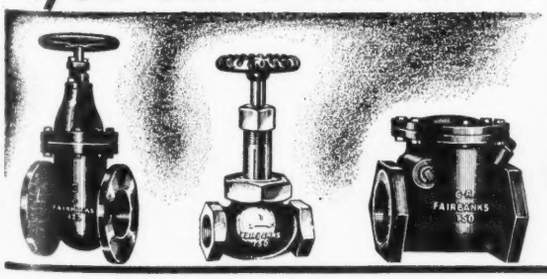
If you don't know the authorized Fairbanks distributor in your area, ask us for his name.

Fairbanks quality valves are backed by over 50 years of specialized experience. Specify "Fairbanks" on your next order. Write for catalog No. 21.

1. Prompt service through conveniently located distributors.
2. Standard and Renewable types for practically every need.
3. Quality in design, materials and workmanship.
4. Uninterrupted service.
5. Low in maintenance cost.
6. Maximum years of service assured.
7. Acclaimed for dependable performance.
8. Nationally accepted by users.
9. Backed by over 50 years' specialized experience.
10. Technical assistance in valve selection.

THE FAIRBANKS COMPANY
397 Lafayette St., New York, N. Y.
Boston, Mass., Pittsburgh, Pa.
Factories: **Binghamton, N. Y., Rome, Ga.**

You can bank on...



FAIRBANKS

as the **RIGHT VALVES TO USE**

"Where to buy it"

. . . WHEN "IT" IS A GAUGE MADE FOR HARD WORK-LONG LIFE AND ACCURACY

Take the Gauge shown below, for example:

Short spring is strong, non-freezable. Pinion, arbor and hair spring are made of Phosphor Bronze and all wearing bearings have Phosphor Bronze bushings twice their diameter in length. Sector is cast bronze, with face three times as wide as the regular sector.

It's designed and precision-built for *maximum* service. And, this is a distinguishing advantage of *all* Lonergan gauges.

TYPE D, STEAM AIR and PRESSURE GAUGE

J. E. LONERGAN CO.
Race and Second Sts., Phila., Pa.

Lonergan

GAUGES

VALVES · SPECIALTIES

300 Specialties for Power Plants-Since 1872

A Floor Patch
THAT'S ALL MUSCLE

Don't patch broken concrete floors with "weak-kneed" materials. Use tough, he-man RUGGEDWEAR Resurfacer for patching or resurfacing an entire area. No chopping or chipping required. Merely sweep out the spot to be patched—mix the material—trowel it on. Holds solid and tight right up to irregular edge of old concrete. Cellulose-Processed to provide a firmer, tougher, smoother, more rugged wearing surface. Used indoors or out. Dries fast. Low in Cost.

Valuable 74-page "HAND BOOK OF BUILDING MAINTENANCE" available to those requesting on business letterhead.

MAKE THIS TEST!

FLEXROCK COMPANY
2377 Manning St., Phila., Penna.

Please send me complete RUGGEDWEAR information . . . details of FREE TRIAL OFFER—no obligation.

Name .....
Company .....
Address .....
City ..... State .....

in which capacity he participated in devising plans for wartime mobilization of electric power supply.

BERT M BROCK has been appointed manager of industrial relation for the John A. Roebling's Sons Co, Trenton, N. J. Mr Brock has been public relations director of the Carnegie-Illinois

Bert Brock

Steel Corp, and prior to that was assistant director of industrial relations for the United States Steel Corp of Delaware, Pittsburgh, Pa. Previously he was manager of industrial relations for the Columbia Steel Co, at San Francisco, Calif.

BUSINESS ITEMS

Three new assistants to J S McNamara has been announced by the INTERNATIONAL NICKEL CO, New York. They are, W J Calnan, H D Tietz, and E A Tturner. At the same time H E Searle, formerly an assistant to Mr McNamara, as manager, engineering sales, for the Monel department, has been transferred to the nickel sales department under R L Suhl, sales manager. B J Bianowicz becomes head of the chemical section of Monel sales to succeed Mr Turner.

J E LONERGAN CO, Philadelphia, Pa., this year celebrates its 70th anniversary. The business was established in 1872 by John E. Lonergan at Second & Race Streets in the heart of old Philadelphia, near Independence Hall. The greatly enlarged, modern plant of the present Lonergan Co is in the same location as it was in 1872.

LINK-BELT CO, eastern stoker division, announces the removal of its sales offices from Philadelphia to the Graybar Building, 420 Lexington Ave, New York, N. Y. K C Ellsworth is in charge of this new office.

UNION IRON WORKS, Erie, Pa., announces appointment of the Engineering

How You Gain
By Reading POWER Regularly

1. **You strengthen the security in your job . . .**

   By keeping abreast of the field's most up-to-date practices.

2. **You equip yourself for a bigger job . . .**

   By learning through the experience of other engineers important things you don't have a chance to learn in your present job.

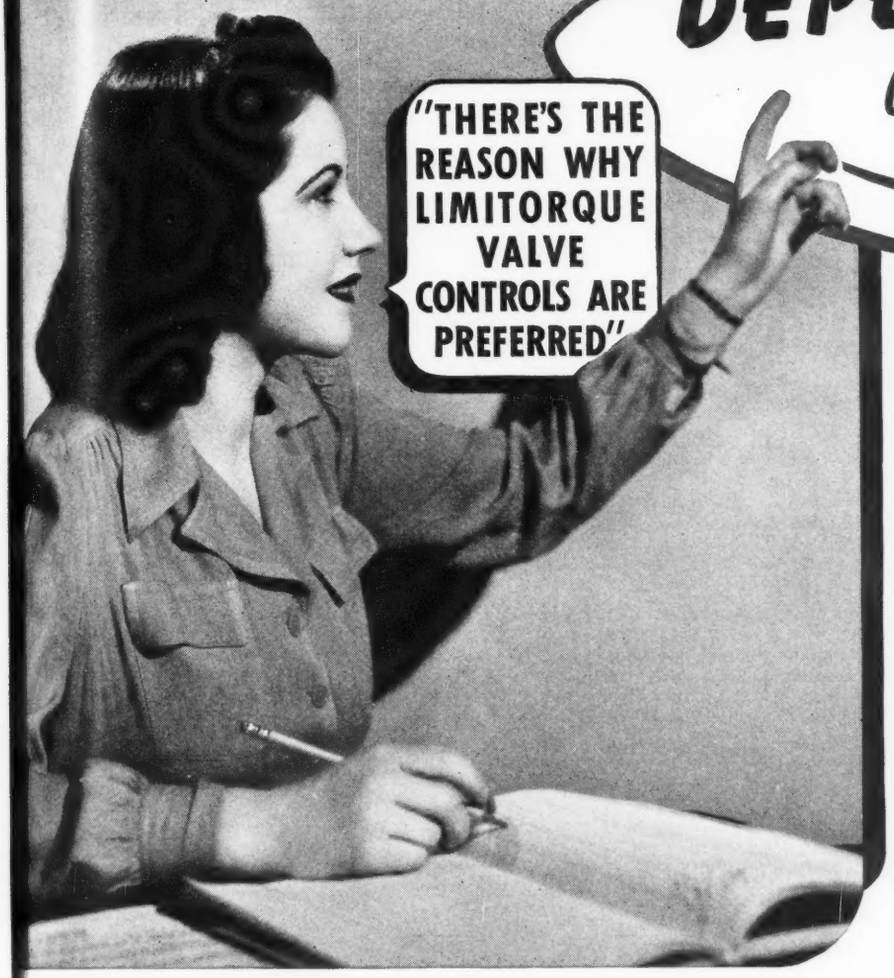
3. **You make yourself an authority in your field . . .**

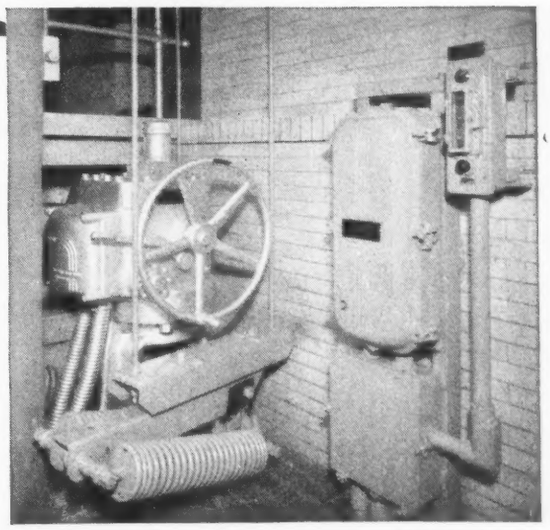
   By constantly accumulating a great store of practical power engineering knowledge that can't be found in books.

Read POWER Carefully

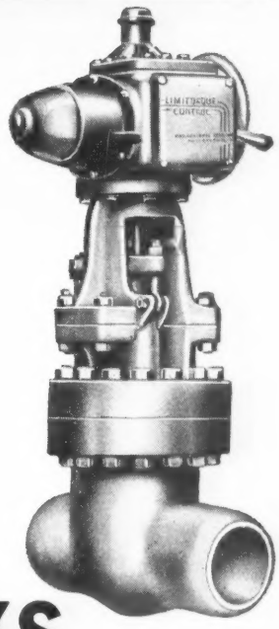
and we guarantee you will get ideas *from every issue* that will more than pay you for the subscription price and the time spent.

DEPENDABLE
UNDER ANY AND ALL CONDITIONS!





One of a group of Limitorque Controls installed in an eastern central station.



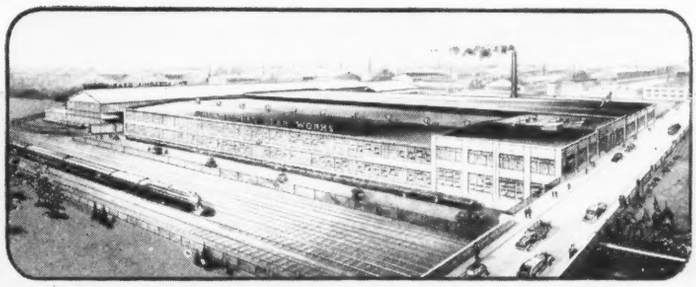
PROVEN during peacetime and "defense" years, Limitorque Valve Operators will continue to prove their *dependability*, come what may.

When designing new plants or for securing better control in existing stations . . . investigate Limitorque. With Limitorque, valves of all types from 3" to 96" diameter can be opened or closed from individual, conveniently located push button stations or from a central master control panel.

If desired, Limitorque can be adapted to existing equipment. Write us for full details.

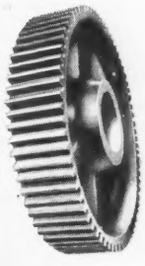
PHILADELPHIA GEAR WORKS

INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

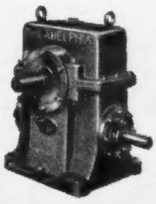


ERIE AVENUE & G STREET
PHILADELPHIA, PA.
New York, Pittsburgh, Chicago

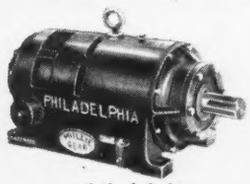
Philadelphia **LIMITORQUE CONTROL** operates all types of valves, etc., safely, economically, from convenient stations.



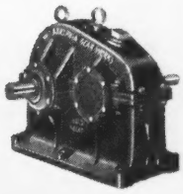
Philadelphia **GEARS** All types and sizes of industrial gears. Can be supplied in all materials.



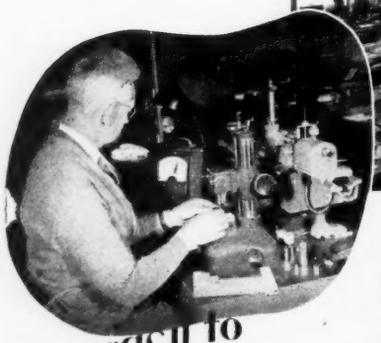
Philadelphia **WORM GEAR SPEED REDUCER** right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.



Philadelphia **MOTOREDUCER** The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.



Philadelphia **HERRINGBONE SPEED REDUCER** for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.



Accuracy to Millionths of an Inch with

The parts for tanks, planes and guns, produced in thousands of separate plants, can only fit together properly if made in standard sizes, to accurate gages. Pratt and Whitney secure accuracy to millionths of an inch by finishing their Hoke precision gage blocks in this air conditioned room at West Hartford, Connecticut.

Standard conditions of 68° F. and 50% relative humidity are maintained, 24 hours a day the year 'round, with Frick Equipment. This working space, covering 16,800 sq. ft., is believed to be more accurately controlled than any other of like size in existence. Full credit is due the Automatic Refrigerating Co., Frick Distributors at Hartford.

Put your air conditioning problem up to the experts who have nearly 60 years' experience back of their recommendations. Write **Frick Co., Waynesboro, Pa.**

TRADE FRICK MARK

Refrigeration

NO LEAKAGE TROUBLES

with ALL-METAL THERMOMETERS

Simplified All-Metal Construction Eliminates Many Trouble Points... Provides Long-Time Dependability!

No liquids, vapors or gases... nothing under pressure... in the all-metal thermometer. Just one movable all-metal part, encased in a stem of stainless steel. Nothing to leak, nothing to wear. Fewer opportunities for trouble.

And it's far simpler to mount the all-metal thermometer, too; for no corrections are ever necessary... regardless of the stem length. In addition, its rugged construction minimizes the possibility of inaccuracies or damage from shock or over-ranging.

WESTON all-metal thermometers are guaranteed accurate within 1% over the entire scale, and are available in types, ranges, scale diameters and stem lengths to suit many industrial applications.

A bulletin containing complete information is available. Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark, N. J.

WESTON ALL-METAL TEMPERATURE GAUGES

Sales Co, 1307 South Michigan Ave, Chicago, Ill., as district sales representatives.

STEWART-WARNER Co announces election of two new vice-presidents, Joseph B Elliff and George L Meyer. Mr Elliff joined Stewart-Warner in June, 1939, and Mr Meyer has been with the company since it was founded.

WOLVERINE TUBE Co, Detroit, announces the resignation of J G Colyer as director and vice-president in charge of sales. Supervision of all sales work will continue under the direction of Otto Klopsch, vice-president and general manager, with Robert Moody as special assistant, William Gernhart as office sales manager, and John Marshall heading the publicity department and electrical sales.

Personnel changes were announced recently by the JONES & LAUGHLIN STEEL CORP., Pittsburgh, Pa. A new district office has been opened in Tulsa, Okla., with R J Woods, Jr, as district sales manager. John B DeWolfe has been appointed district sales manager

S A Fuller

at Washington, D. C. S A Fuller has been appointed district sales manager to the New York district, and Ernest W Harwell has been made district sales manager in Chicago. E E Hoehle has been appointed district sales manager at Memphis, Tenn.

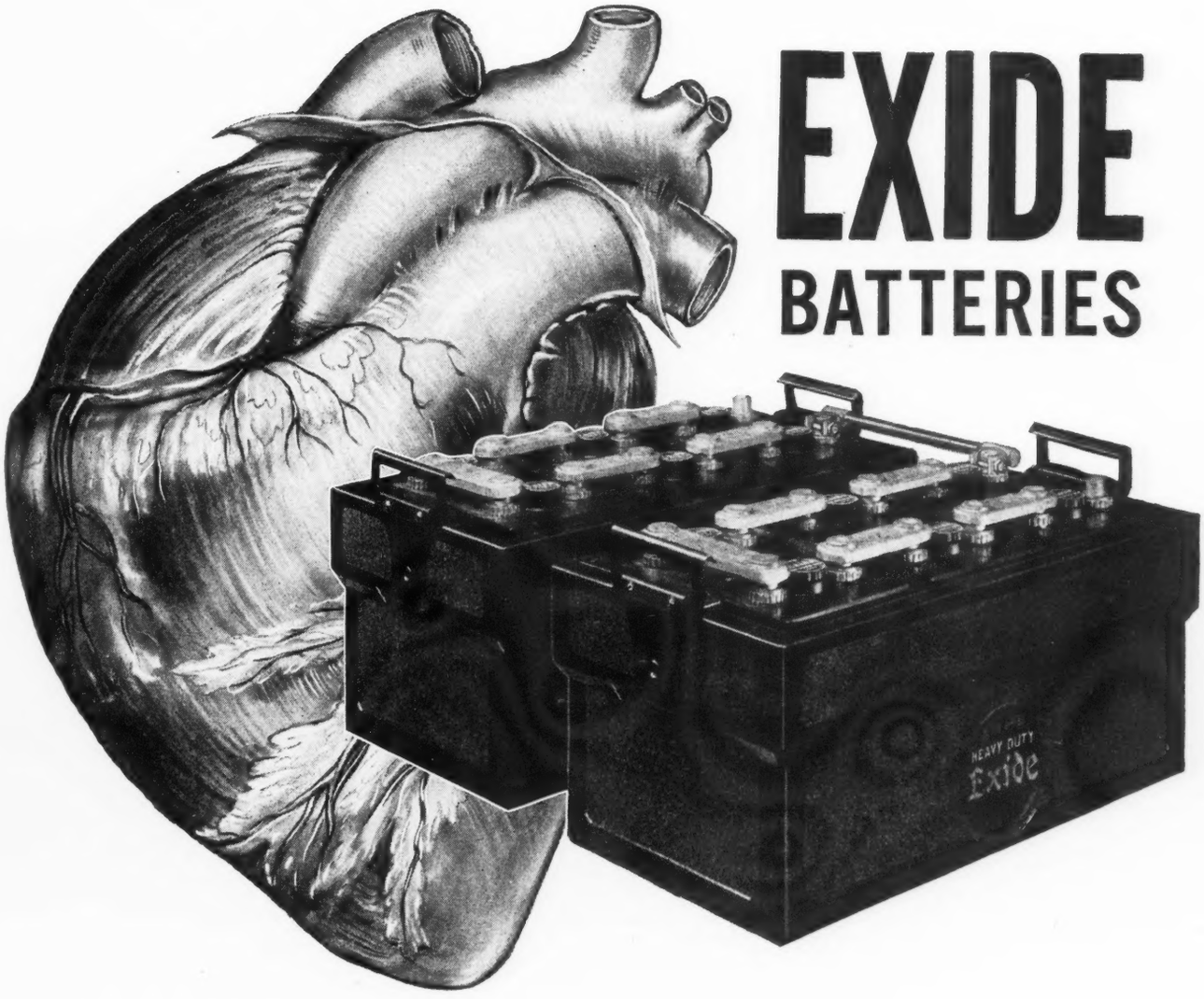
MEETINGS

American Society of Mechanical Engineers—*Spring Meeting, Rice Hotel, March 24–25, 1942, Rice Hotel, Houston, Texas. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

National Association of Fan Manufacturers—*25th Annual Meeting, February 12, 1942, Detroit, Mich. L O Monroe, secretary, General Motors Bldg, Detroit, Mich.*

Technical Association of the Pulp and Paper Industry—*Annual Meeting, February 16–19, 1942, Commodore Hotel, New York, N. Y. R G Macdonald, secretary, 122 E 42 St, New York, N. Y.*

To start the heartbeat of a Diesel....



EXIDE BATTERIES

IT takes a husky battery to make the life-blood of action course through a Diesel engine. It takes a dependable battery to crank a cold Diesel in sub-freezing weather.

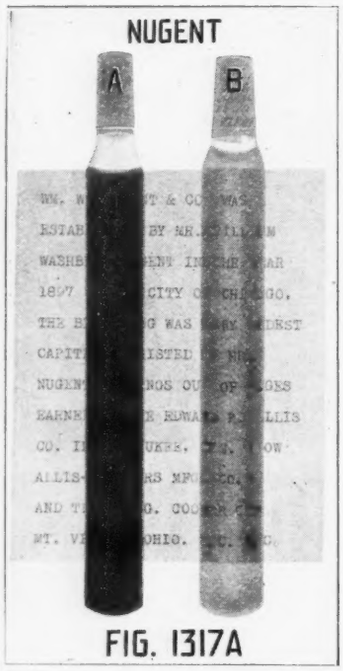
Yet whatever the weather, whatever the Diesel, there's an Exide Battery to do the job right.

Exide Batteries pour out their tremendous reserve power at high voltage . . . for faster cranking. Exide Batteries have proven their worth in locomotives, industrial plants, construction camps, ships . . . in fact, wherever Diesel engines are used. There's an Exide Battery for every size and type of Diesel. No job is too big for an Exide.

Exide
BATTERIES
FOR CRANKING
DIESEL ENGINES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

↓ ↓ ↓ Here's the way Lube Oil Looks BEFORE and AFTER *Passing through a* NUGENT FILTER!



(Taken from an actual, unretouched photograph.)

BEFORE: **Shown at the left is a sample of dirty crankcase oil taken from a 300 H.P. gas engine *before* installing Nugent Filter.**

AFTER: **At the right is a sample of oil from the same engine *after* installing Nugent Filter, and operating 1,344 hours before cleaning filter.**

—This is the kind of protection against dirt troubles you get for *any* kind of oil when you use Nugent Pressure Filters. Write for complete information and literature on Nugent Filters—Sight Feed Bearing Oilers—Telescopic Crank Pin, Crosshead Pin and Eccentric Oilers—and other lubrication specialties.

WM. W. NUGENT & CO., INC., Established 1897
402 N. Hermitage Ave., Chicago, Illinois

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

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Mamaroneck, N. Y.

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Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

BETTER SERVICE — SAFETY — SATISFACTION
FOR REPLACEMENTS ORDER

PRECISION GAGE GLASSES and GAGE GLASS GASKETS THAT WILL NOT BLOW OUT

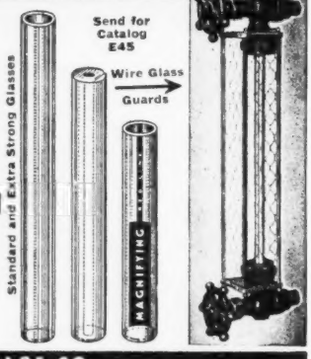
Standard Square Cut Gaskets High Pressure Non-hardening and Non-softening

GASKETS THAT WILL FIT EXACTLY

Red Lip-mold Pattern Expansion Type Gasket

Send for Glass and Gasket Chart

Shipment made by parcel post the same day as order is received



Send for Catalog E45

Wire Glass Guards

ERNST WATER COLUMN & GAGE CO.
RUBBER & GLASS DIVISION LIVINGSTON, NEW JERSEY

GENERAL ELECTRIC CO announces personnel changes. Elliott Harrington, for the past year sales manager of the General Electric air-conditioning and commercial refrigeration department at Bloomfield, N. J., has been named manager of sales of the Schenectady induction motor section of the GE motor division. A G Jones has been made district manager of the Pacific district central station transportation department, and S W Scarfe has been appointed manager of the Los Angeles central station department. E P Waller, assistant to E O Shreve, vice-president in charge of apparatus sales, retired on Jan. 1, 1942, after completing 41 years of service with the company. Mr Weller was first associate editor of the "General Electric Review." H H Barnes, Jr. General Electric commercial vice-president, retired Jan 1, after completing 40 years of service. Mr Barnes has been in charge of the company's activities in the New York district since May, 1928. R W Adams has been assistant district manager, New England district; R W Herrick, manager of the central station department, New England district; and G E Walch, manager of the Providence office.

B F GOODRICH CO., Akron, Ohio, announces that Dr Howard E Fritz, manager of the synthetic division for the past seven years, and one of the best known technical men in the rubber industry, was named director of research of the company. Dr Fritz joined B F Goodrich in 1925 from the Engineering School faculty of Ohio State University, Columbus, Ohio, from which he was graduated in 1914. In 1934 Dr Fritz took over the direction of the development and sales of Koroseal, the synthetic elastic discovered in the company's laboratory. William S Richardson has been made general manager of the company, succeeding J H Connors, who has resigned because of ill health. Richardson was staff superintendent of the mechanical division, and in 1931 was made merchandising manager of the mechanical goods sales division.

JENKINS BROS, 80 White St, New York, N. Y., announces that because of increased productive capacity of corrosion-resisting-alloy valves, it is in the position to offer faster delivery on these valves for orders having high priority ratings.

THE TIMKEN ROLLER BEARING CO, Canton, Ohio, announces transfer of F H Lindus to sales promotion work located in Canton, Ohio. He has been with the

WATER CONDITIONING at

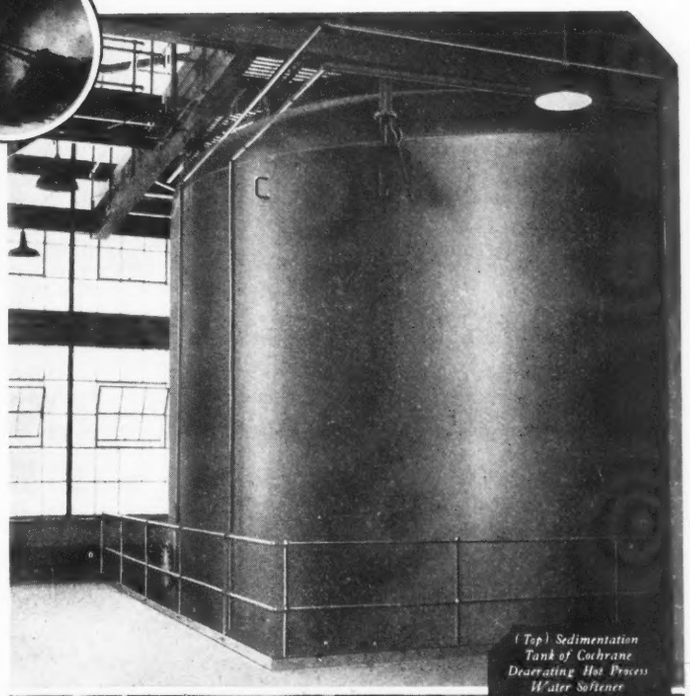
Radford ORDNANCE WORKS

RADFORD, VIRGINIA

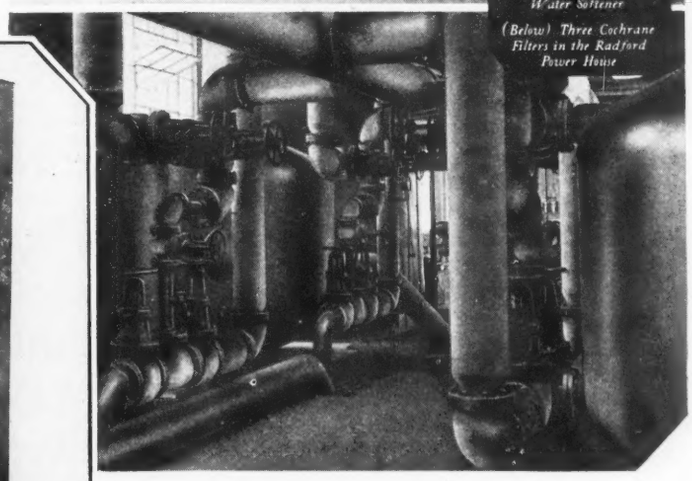
THE Radford Ordnance Works, producing smokeless powder, is part of the great network of munitions plants constructed for the War Department. Designed and operated by Hercules Powder Company, the power plant is supplied by four giant steam generators supplied with feed water of "zero" hardness and "zero" oxygen by a Cochrane Deaerating Hot Process Softener.

Feedwater is first treated with phosphoric acid, subsequently deaerated, and then—with the addition of caustic soda and magnesium salts—the hardness is reduced to zero. Silica is reduced to less than one part per million. Operating results have indicated no sludge accumulations either in the boilers or in the steam washers with which the boilers are equipped.

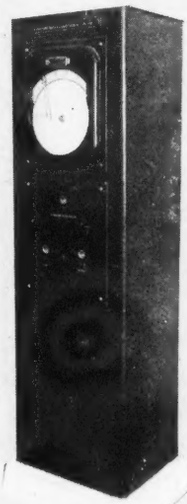
Chemical proportioners are electrically operated by a Cochrane Flow Meter, with individual feeds for individual chemicals so that adjustment of the chemical feeds for varying raw water conditions can be made by the turn of a knob.



(Top) Sedimentation Tank of Cochrane Deaerating Hot Process Water Softener



(Below) Three Cochrane Filters in the Radford Power House



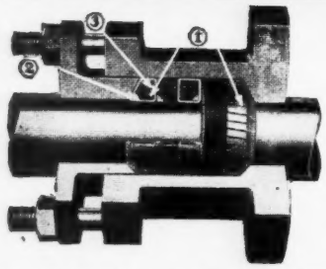
Cochrane Flow Meter and Individual Controls on Panel. Individual Controls govern proportions of phosphoric acid, caustic acid and blow-down recirculation

Cochrane Corporation

3106 N. 17TH STREET PHILADELPHIA, PA.

WATER SOFTENERS • DEAERATING HEATERS • FILTERS • BLOW-DOWN EQUIPMENT • VALVES • FLOW METERS

There are 3 INDIVIDUAL SEALING ELEMENTS



in SEA-RO ARMORED NEK-SEAL PACKING No. 1505

1. **ARMORED CASING** of anti-friction foil provides full metallic surface that will not score.
2. **NEK-SEAL FILLET** of foil at pressure corner of packing—provides extra sealing and prevents crowding out of stuffing box.
3. **SEMI-METALLIC CORE**—anti-frictional and resilient—assures proper contact with rod or shaft.

Sea-Ro Armored Nek-Seal Packing No. 1505 is recommended for reciprocating or centrifugal equipment, operating against extreme pressures and speeds. Write for details.

SEA-RO PACKING CO., INC., WOOD-RIDGE, N. J. SEA-RO

HI-TEST **KEWANEE**

POWER, INDUSTRY OR PROCESS STEAM

Cut-away view showing refractory lined firebox

A quick steaming, *All-Welded* portable boiler, economical to handle.

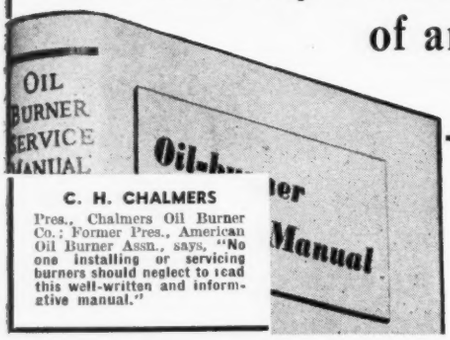
Refractory lined firebox and two-pass tubes are easy on the fuel bill. 6 sizes, 50 to 150 H.P.

125 and 150-lb. steam working pressure.

For 6" rule with scale for reading pipe sizes, write Dept. 89 K-II.

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

How to analyze and correct troubles of any type oil burner DOUBLE-QUICK



C. H. CHALMERS
Pres., Chalmers Oil Burner Co.; Former Pres., American Oil Burner Assn., says, "No one installing or servicing burners should neglect to read this well-written and informative manual."

Today's money-making opportunities in oil burner servicing are keyed not only to how well the work is done but how fast. With this practical book you can locate, diagnose and correct all operational and constructional troubles of any type or recognized make burner without delay or doubt—and thus increase earnings.

OIL BURNER SERVICE MANUAL

By K. STEINER
Consulting Engineer, Ray Heat & Power Co.
and F. RAVNSBECK
Chief Engineer, Ace Engineering Co.
365 pp., 6x9, illus., $4.00

Gives the mechanic just the help he needs in installing and servicing oil burners, in plain language. Exhaustive treatment given to domestic burners, including all recognized makes from earliest to current types. Commercial and industrial installation, maintenance and service are thoroughly discussed and illustrated. Gives countless pointers secured from men actually engaged in handling the various burners and accessories.

16 CHAPTERS COVER:

- Domestic Pressure-atomizing Oil Burners.
- Domestic Vertical-cup Burners.
- Rotary Wall-flame Burners.
- Low-pressure Atomizing Domestic Burners.
- Miscellaneous Domestic Burners.
- Horizontal-rotary Oil Burners.
- Miscellaneous Industrial Oil Burners.
- Refractories.
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MAIL COUPON FOR 10 DAYS' FREE TRIAL

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C.
Send me Steiner and Ravnsbeck's Oil Burner Service Manual for 10 days' examination on approval. In 10 days I will send $4.00 plus few cents postage, or return book postpaid. (Postage paid on orders accompanied by remittance.)

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(Books sent on approval in U. S. and Canada only.)

Timken Co since 1935, serving as Los Angeles branch manager of the service division until he was transferred to the central headquarters at Canton a few months ago.

THE FOXBORO CO, Foxboro, Mass., is celebrating its tenth anniversary this year. Company announces that today, 11 people of the original founders are a part of the pyrometer department at Foxboro. They are, C J Brown, W G McAllister, O S Michael, William Livesy, Alex McCrary, E A Williams, Philip Traphagen, Isaac Fleischmann, S C Horn, George Smith, and Louise Zielke.

HOWARD M TURNER and SAMUEL M ELLSWORTH, consulting engineers specializing respectively in the hydroelectric and sanitary engineering fields, have moved their associated offices to 6 Beacon Street, Boston, Mass. Mr Turner was identified with the hydroelectric development of the Turners Falls (Mass.) Power & Electric Co before going to Boston to engage in private practice. Both consultants are lecturers at the Harvard Graduate School of Engineering, Cambridge, Mass.

STANLEY M HUNT has been appointed assistant superintendent of the northern division of the NEW ENGLAND POWER SYSTEM, with headquarters at Littleton, N. H., reporting to Harry B Soper. He succeeds the late Harry K Patterson, who died suddenly on Nov 10, 1941. Raymond C Whicher, formerly superintendent of the Comerford and McIndoes hydroelectric plants of the affiliated Connecticut River Power Co, has been made supervisor of operations with offices at Littleton. Frank Carlisle, assistant superintendent of the Comerford station, has been made station superintendent of the Comerford and McIndoes plants. Maurice E Lake, formerly superintendent of production, Green Mountain Power Corp., Montpelier, Vt., has been appointed superintendent of transmission and distribution with offices at Littleton.

Seventeen engineers on the staff of the STONE & WEBSTER ENGINEERING CORP, Boston, Mass. have been promoted to higher ratings now in effect. These are: Samuel P Melville, Charles W Maloney, Algodt J Seaburg and Eric A Stroberg, rated as electrical engineers; Chester W Welch and Charles A Whittemore, industrial engineers; Alton Kirkpatrick, Burton C Mallory, James A Powell, Charles R Stewart, and Alden D White, mechanical engineers; Harry

Nasty silica problem mastered by PHOSCALOID for large carpet mill in eastern Pennsylvania using Zeolited well water.

Treatment started November 4, 1935

Feb. 29, 1936 Plant reported "marked signs of improvement since using Phoscaloid".

Sept. 13, 1936 "found internal surfaces of boilers and feed lines very satisfactory".

July 2, 1937 "Inspector examined No. 1 and No. 2 boilers—advised turbining first three rows of tubes in each boiler in which there was light powdery scale".

March 25, 1938 "There appeared to be very little corrosion in section of pipe inspected beyond where the Phoscaloid is being fed".

Dec. 15, 1938 "inspected No. 1 and No. 2 boiler and found very little scale".

July 13, 1939 "No. 1 and No. 2 boilers were shut down from July 1 to July 5 for cleaning, inspection, etc."—"There was very little scale in the boiler proper and what with fire hose was light and powdery"—"washing down was sufficient cleaning".

July 4, to 7, 1940 "Boilers No. 1 and No. 2 opened for inspection"—"good conditions reported in tubes and drums".

Feb. 11, 1941 "Inside of drums and tubes of No. 2 boiler very clean and only a light, powdery scale in mud drum which was readily removed with a brush".

This represents six year's continuous freedom from Silica troubles with only an occasional use of the hose or brush to keep the water surfaces clean to the metal and at less expense than commercial phosphates.

Such results are made possible by the fact that the reactive Proteins in Phoscaloid destroy the scale-forming properties of five to seven times more Calcium than do commercial phosphates. The resulting non-structural Calcium Proteinates are the dominant influences here in the effective prevention of Silica troubles.

More information on request.

CYRUS WM. RICE & COMPANY

WATER CHEMISTS & ENGINEERS

PITTSBURGH

PENNA.

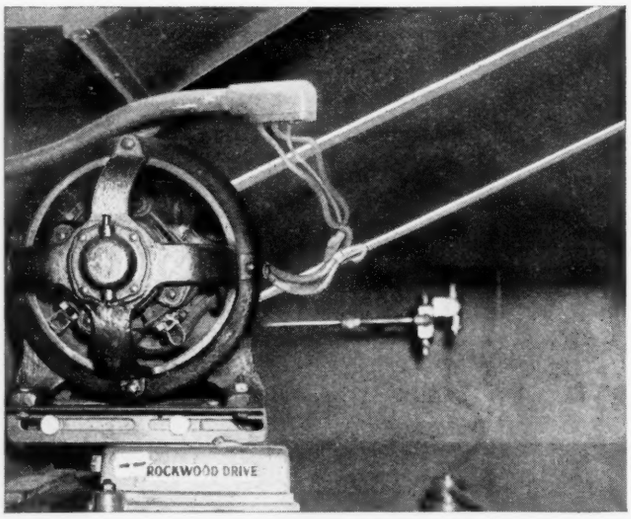
CWR

Remember

—Phoscaloids are Plentiful Sources for Phosphates, and are inexpensive.

IF YOU CANNOT GET MORE MACHINES . . .

get more production from those you have!



Choose the type of drive that is now delivering nearly 2,000,000 H.P. in American Industry!

Rhoads Tannate-Rockwood drives (motor mounted on a Rockwood pivoted motor base and equipped with a Tannate Watershed Leather Belt) earn ever growing preference for *rightness* on the job.

Machines do more and better work. Maintenance is at a minimum. Power is saved. Correct belt tension is maintained automatically at all times. This saves wear on belt and bearings.

Use them

to step up capacity of present machines;
to increase the production of new machines;
to keep machines on the job.

Tannate-Rockwood drives can be installed quickly and economically. Let us tell you how they can help you do your job. Write for details.

J. E. RHOADS & SONS
Established 1702
35 North Sixth St., Philadelphia, Pa.
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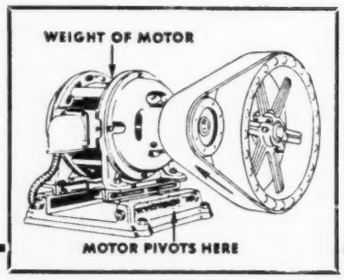


RHOADS *Tannate-Rockwood* the ideal **SHORT CENTER DRIVE**

S Houghton, chief petroleum engineer, and Robert J Carter and Arthur W Pratt, petroleum engineers; Edward E Bigelow, Robert D Chellis and Linton Kerr, structural engineers.

HAHN ENGINEERING Co has become a division of the Luria Steel and Trading Corp with headquarters in the Woolworth Building. Eugene Hahn will direct the activities of the new division.

JOHN A ROEBLING'S SONS Co announces the retirement of Raymond R Newell as manager of the Cleveland branch. Mr Newell had been associated with the company for 39 years. Eugene King, former assistant manager under Mr Newell, has been appointed to the managership. Mr King joined the company in 1917.

Construction of a $25,000,000 factory at Fort Wayne, Ind., for the manufacture of turbo-superchargers for airplanes was begun December 2, 1941 for the GENERAL ELECTRIC Co. The building, to be erected by Stone & Webster of Boston, Mass., is expected to be completed by July 1, this year. Approximately 4000 employees will be required at peak production.

BURLINGTON INSTRUMENT CORP, Burlington, Iowa, announces appointment of Equipment Sales Div, 21 East Van Buren St, Chicago as sales representatives in the Chicago territory.

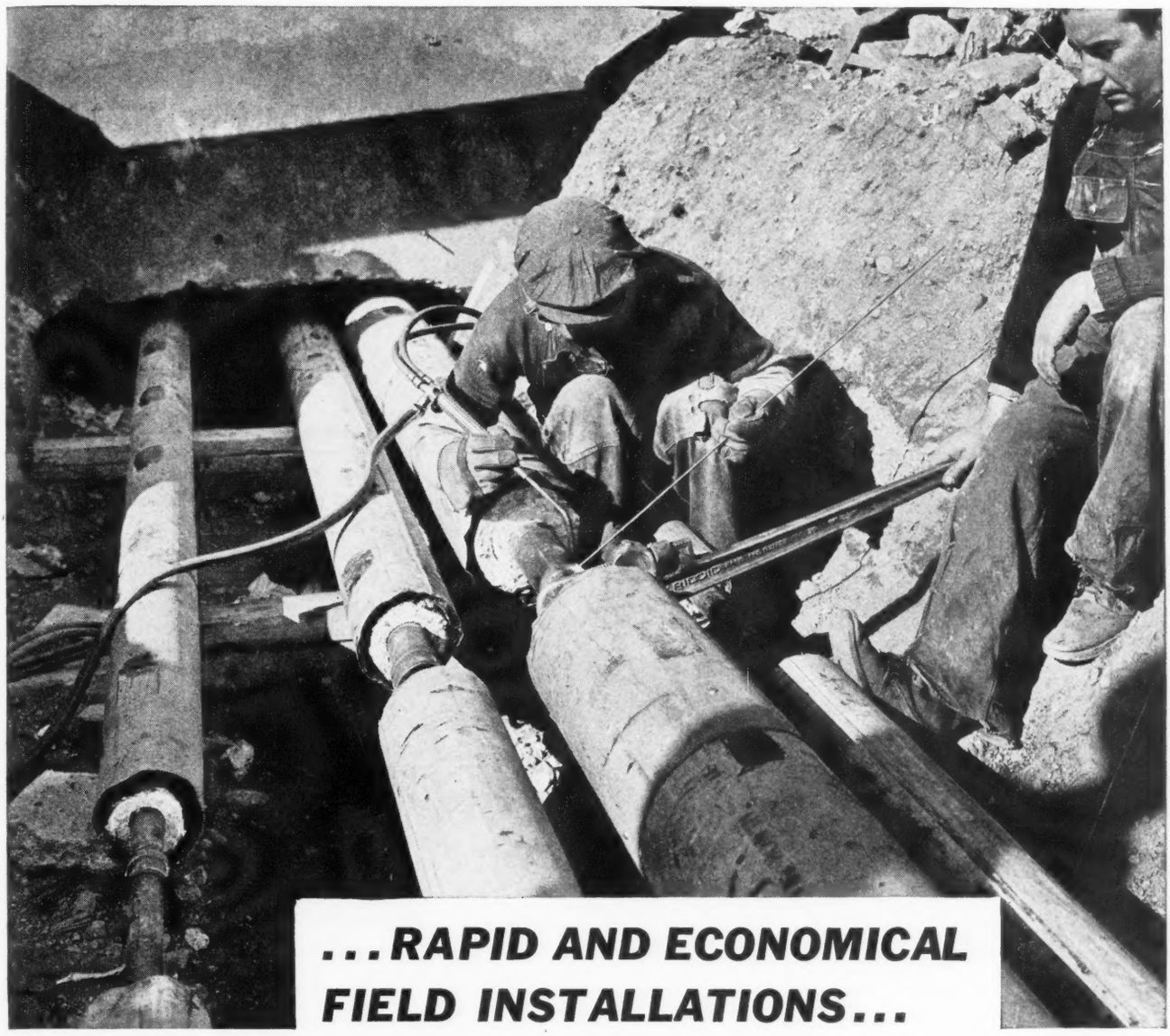
PERMUTIT Co OF CANADA, LTD, has recently appointed S A McWilliams, Ltd, 60 Front Street West, Toronto, Ontario, Canada, as its representative in the province of Ontario. Permutit of Canada Ltd continues to be represented in Montreal by C K McLeod and by Stanley Brock, Ltd, in Winnipeg and Calgary.

In a recent issue of POWER the BIRD-ARCHER Co announced the appointment of G C Walker as sales manager. This is in error. Mr G C Walker is Eastern industrial sales manager; Mr E A Lowenthal is Western industrial sales manager and Mr George H Sill is railway sales manager of the company.

BORNE SCRYMSER Co announces removal of its executive and sales offices from 17 Battery Place, New York, N. Y. to 632 South Front St, Elizabeth, N. J., effective December 1, 1941.

CHAIN BELT Co announces appointment of Dow & Co, 1820 Elmwood

FOR UNDERGROUND PIPE LINES



...RAPID AND ECONOMICAL FIELD INSTALLATIONS...

with EHRET'S DURANT INSULATED PIPE

Laying underground insulated pipe lines is both rapid and economical when you use the Durant Insulated Piping system. This pre-insulated and pre-sealed system comes to you in completely finished units, ready for installation. No tile or concrete tunnels are required and there is nothing extra to buy. The pipe supports are self-contained and the piping units can be laid with a minimum of trenching and field work. The asphalt protection is permanently water-proof and the 85% Magnesia insulation will maintain its efficiency throughout the years.

Write us today for your copy of the new Ehret 176-page Insulation Handbook, #A202, which describes the D. I. P. system as well as many other Ehret products. *It's free.*

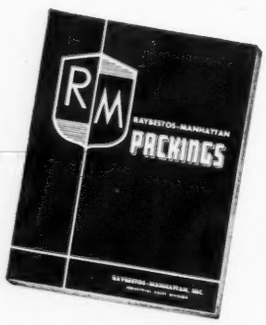
EHRET MAGNESIA MANUFACTURING CO.
VALLEY FORGE, PENNA.

...THERE IS AN *EHRET* DISTRIBUTOR OR CONTRACTOR IN EVERY INDUSTRIAL AREA

R/M PACKINGS *help you* JUGGLE WAR PRODUCTION

Even under the increased speeds and strains and stresses of industry geared for war, R/M packings keep everything under control. Gas, air, water, oil, and vital chemicals flow smoothly, operate efficiently, *keep going*. For R/M packings last—and last. Machinery does not break down. Repairs are reduced. Production speeds up without a hitch—maintains overtime schedules without dangerous delays.

To a nation at war R/M is important as never before. *For R/M is dependable!*



Your production problems can be solved with the right R/M packing. Ask your jobber for the complete cross-indexed catalogue of the most compact line of packings anywhere, or write us for a copy—on your business letterhead. Specify R/M—and

Keep Machinery Rolling!

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

Ave. Buffalo, N. Y. as distributor of company products in the Buffalo and Rochester area.

LINCOLN ELECTRIC Co, Cleveland, Ohio, announces opening of new offices in Jacksonville, Fla. Mr J M Chapple, formerly with the Detroit office, will be in charge of the new branch.

Magnesium from the Sea

New American plants are making magnesium from sea water in such quantites that the United States and England are now equalling and will surpass Germany in production of this strategic metal, Dr. R H Harrington, metallurgist in the GE research laboratory, declared in a Science Forum address over Schenectady (N. Y.) Station WGY.

An authority on alloys and their heat treatment, Dr Harrington said that the largest single use of magnesium, a metal only two-thirds as heavy as aluminum, is as an alloying element in aluminum-base alloys, many of which are used in airplanes.

"Of the common engineering metals, magnesium is about the only one in which Germany is self-sufficient, and, up to three years ago, Germany, using magnesium and its alloys as a main 'ersatz' substitution material, produced about three-fourths of the world's consumption," Dr Harrington pointed out. "Today, England and our country together are probably equalling the German output and, next year, should exceed German production in magnesium.

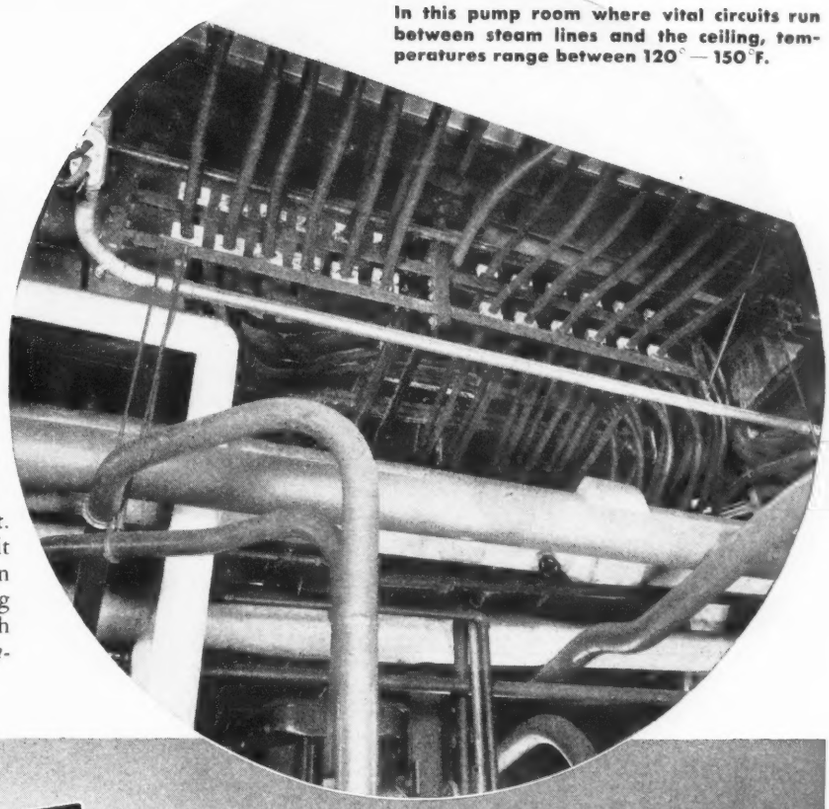
"Early in 1939," he continued, "it became apparent that the metal supply would be inadequate, and new production facilities were provided which increased the production by nearly 100 per cent to 12 million pounds for 1940.

"Present production made possible a yield of 30 million pounds for 1941 and indicates a yield of nearly 90 million pounds in 1942—from six million to 90 million pounds in three years."

This remarkable expansion is being made possible by new plants using sea water as a source, according to Dr Harrington.

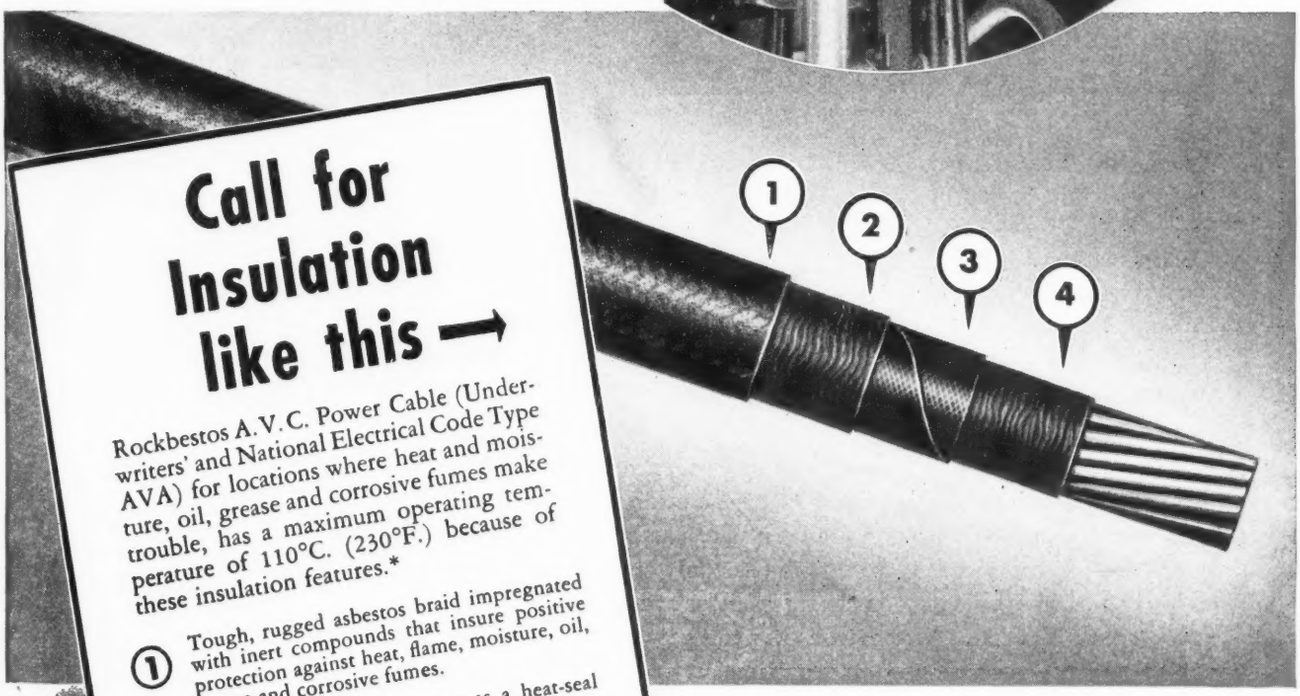
"Even though the concentration of magnesium in sea water is quite low, there are about four and one-half million tons of magnesium in a cubic mile of sea water," he said. "Thus only one cubic mile of sea water will furnish

Installations like this →



In this pump room where vital circuits run between steam lines and the ceiling, temperatures range between 120° — 150°F.

If your plant has any power, control or lighting circuits keeping company with steam lines, boilers, furnaces, lehrs, soaking pits, or operating anywhere else under high temperatures — you'll have trouble sooner or later if the wire isn't *permanently insulated* against heat. You know what heat does to wire — it bakes ordinary insulation to a crisp — then comes failure, shut-downs and a rewiring job that could have been avoided with Rockbestos, *the wire with permanent insulation.*



Call for Insulation like this →

Rockbestos A.V.C. Power Cable (Underwriters' and National Electrical Code Type AVA) for locations where heat and moisture, oil, grease and corrosive fumes make trouble, has a maximum operating temperature of 110°C. (230°F.) because of these insulation features.*

1. Tough, rugged asbestos braid impregnated with inert compounds that insure positive protection against heat, flame, moisture, oil, grease and corrosive fumes.
2. Felted asbestos which serves as a heat-seal against high ambient temperatures.
3. High dielectric, moisture resistant, asbestos-sealed insert of lubricated varnished cambric.
4. Another felted asbestos wall which provides protection against conductor-heating overloads and copper-melting arcs.

* This type of insulation also used in lighting wire, control cable, motor lead cable and other Rockbestos A.V.C. constructions.

Plan now to prevent equipment outage and keep production moving with *permanently insulated* Rockbestos. Anticipate your minimum footage requirements and furnish preference rating forms when ordering. For a catalog showing many of the 118 standard constructions write to:

Rockbestos Products Corp., 835 Nicoll St., New Haven, Conn.

PERMANENTLY INSULATED ROCKBESTOS WIRES AND CABLES

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

"E" stands for teamwork!

"It gives me pleasure to advise you that your organization has been chosen to receive the flag of the Bureau of Ordnance and the Navy 'E' pennant in recognition of your outstanding efforts in the production of ordnance materiel vital to our national defense. Recent events have made this award of even deeper significance than any which have been made in the past."
Secretary of the Navy Frank Knox, in a letter to Monsanto.

Among the crews of Uncle Sam's warships and naval planes, the Navy "E" is one of the most coveted and respected honors the men of a single gun turret or an entire battleship can win.

It is a symbol, not of individual brilliance, but of championship teamwork . . . teamwork that only long, gruelling hours of actual practice could perfect.

The same tradition governs the award of a Navy "E" to an industrial plant.

The "outstanding jobs" which win an Ordnance Bureau flag and "E" pennant are not the work of one brilliant "lone wolf" in the research department—or a single, capable executive. They are the result of teamwork that only starts with the quarterback in the front office and includes every man in the organization to the policeman on the plant gate . . . teamwork that only long years in the peacetime service of industry could perfect to the peak of efficiency demanded by a nation at war!

MONSANTO CHEMICALS

Monsanto is proud to fly the Navy "E" in recognition of past performance . . . glad to accept the responsibility it imposes for future performance. MONSANTO CHEMICAL COMPANY, ST. LOUIS, MO.

SERVING INDUSTRY . . . WHICH SERVES MANKIND

90 million pounds of magnesium metal each year for 100 years!"

US Education Bureau Produces Sound Films

A series of sound films, produced by the U. S. Office of Education, Federal Security Agency, to assist potential and employed defense workers more rapidly to learn and more thoroughly to comprehend the instruction being given them in the vocational schools throughout the country, has been announced by Dr John W. Studebaker, U. S. Commissioner of Education.

Fifty reels of film, eighteen of which have been completed and the balance of which are now in production, comprise the series. These films will be reproduced in 16-mm size and made available at low cost to training centers, vocational schools, and industries offering apprentice training. The contract for distribution was awarded to Castle Films, Inc., on a competitive basis, which will sell the sound-on-film reels at less than nine dollars a reel, (See photo on page 122).

Machine Tool Handling

Presenting a detailed course in the handling of machine tools in precision work, 40 of the films are on the subject of machine-shop practice. Seven reels are devoted to the engine lathe, five reels cover precision measurement, five are on the vertical boring mill, five on the milling machine, five on the use of drill presses of various types, seven on bench work, three on the shaper, two on the action of single point cutting tools, and one on centering and layout. In addition, ten reels still in production cover operations in shipbuilding.

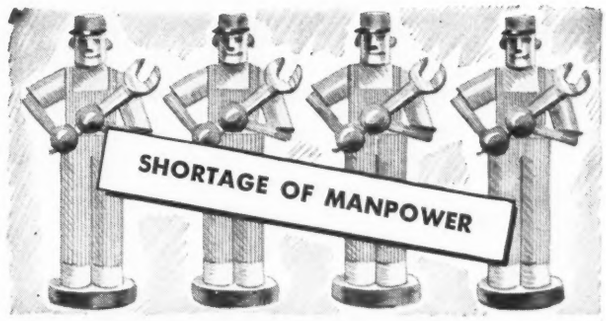
As an example of the detailed instruction provided by the films, the five subjects treated in the reels on the engine lathe are: rough turning between centers; turning work of two diameters; cutting a taper with the compound rest and with the taper attachment; drilling, boring and reaming work held in chuck; and cutting an external national fine thread.

Made by Eight Concerns

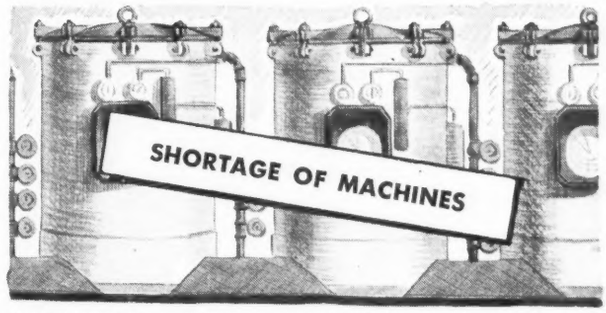
The films, which follow a pattern developed by the U. S. Office of Education, were made by eight companies engaged in the production of commercial motion pictures. Cooperating in the venture, machine tool manufacturers, industrial plants and vocational training experts provided equipment

NOT 1 BUT 5
FOR YOU TO LICK

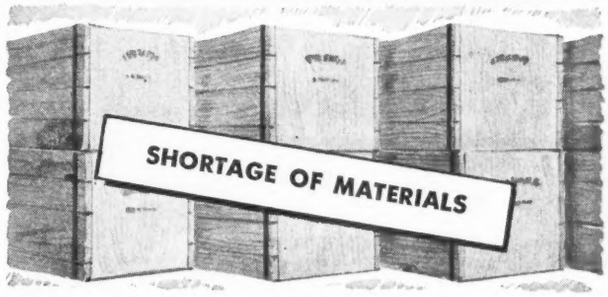
How Taylor Instruments can help you win the fight you've got to win!



USE TAYLOR INSTRUMENTS to help you lick a *shortage of manpower* that may be crippling your power to produce. Taylor Instruments are designed to relieve your human operators of much mere "watchman" work on processing operations. They automatically guard precision production. Using Taylors, even your unskilled operators can turn out skilled results. Taylor Instruments free your skilled operators for jobs where their skill is even more urgently needed. And Taylors relieve all your men of much of the strain of longer hours at high speed—a "crack-up" danger threatening all industry.

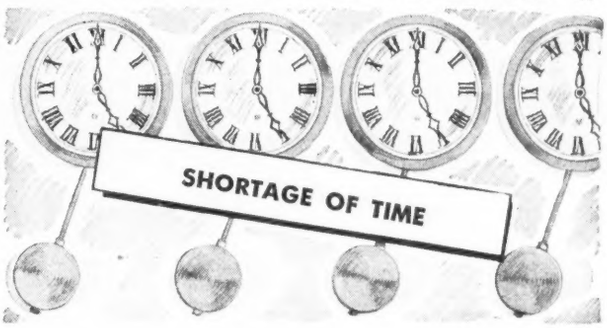


USE TAYLOR INSTRUMENTS to help you lick a *shortage of machines*. Taylor Instruments can help your *essential* equipment to produce fast and well. You may not be able to get more equipment now, but you may be able to get more work now from the equipment you have.



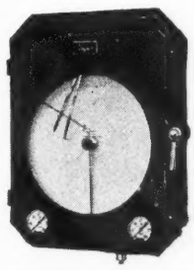
USE TAYLOR INSTRUMENTS to help you lick a *shortage of materials*. Many materials are scarce these days, and getting scarcer. Taylor Instruments should be doing a big job of waste-prevention for you—helping you get every possible use out of what you've got. If you're using the substitute materials which are proving themselves such good soldiers in the fight, remember that the precision control made possible by Taylor Instruments is responsible for the very existence of many of these substitutes.

USE TAYLOR INSTRUMENTS to help you lick *high manufacturing costs*. Where prices were "pegged," as of July 29, 1941, manufacturers had to absorb future increases in labor and material costs. You've got to keep *your* production costs down, and keep them from increasing. You should be able to *cut* your production costs, by using Taylor Instruments to eliminate waste. Taylor Instruments can help you insure top quality at top speed, with minimum waste.



USE TAYLOR INSTRUMENTS to help you lick *shortage of time*. Save time by speeding up your plant operations. You *can* save time safely, because Taylor Instruments eliminate the slow-down caused by human errors. Rely on Taylor Instruments to help do things right—and do them fast.

Taylor Instruments can help you *now*, when America needs *your* production. Call on Taylor today. Tell us how we can help you — fast. Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada.



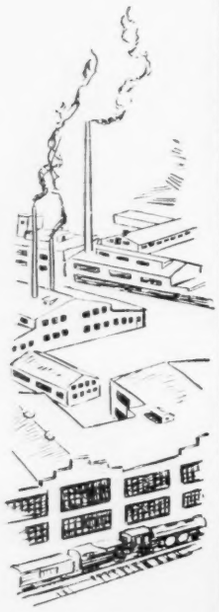
The New Taylor Fulscope Controller, Protecting America's Power to Produce with Not 1 but 5 Forms of Control

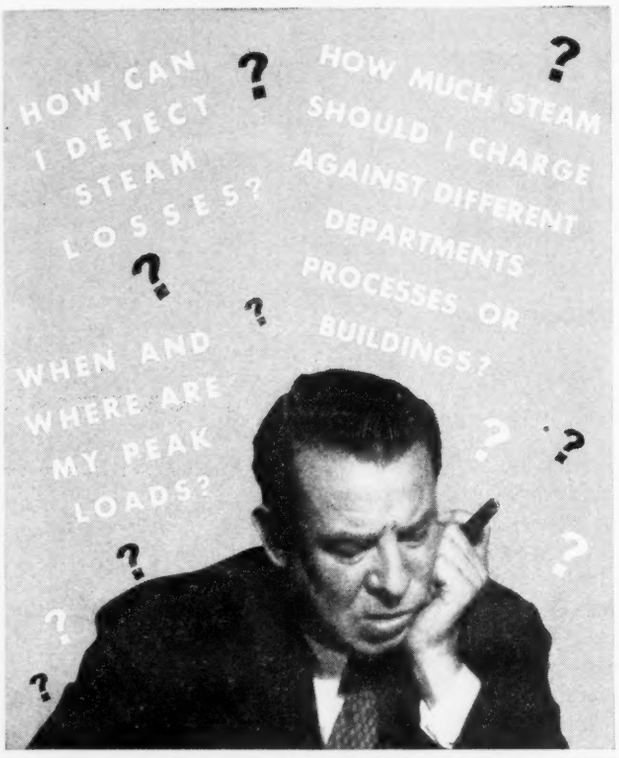
Taylor-MADE MEANS BETTER MADE IN AMERICA BY AMERICANS

Taylor

Indicating Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* LEVEL INSTRUMENTS




HOW CAN I DETECT STEAM LOSSES?
HOW MUCH STEAM SHOULD I CHARGE AGAINST DIFFERENT DEPARTMENTS PROCESSES OR BUILDINGS?
WHEN AND WHERE ARE MY PEAK LOADS?

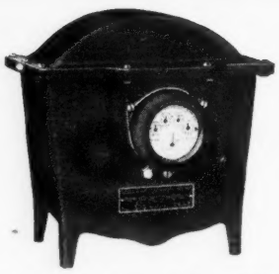
LET ADSCO ROTARY CONDENSATION METERS Give You The Answer

How can you arrive at accurate steam costs for separate buildings, departments or processes? . . . How can you stop steam losses unless you know where they are?

You can have this information and it won't cost you a fortune to get it. Simply install ADSCO Rotary Condensation Meters.

These low cost meters are quickly installed and easily maintained. Their accuracy (factory tested within 1%) has made them the standard for leading industrial plants, colleges and district heating companies. Meter counter records in pounds of condensate on a non-fogging dial and the meter is sealed at three points to prevent tampering with the mechanism.

Tell us the maximum pounds of condensate per hour or the square feet of equivalent direct radiation in the building or department to be metered and we will tell you how surprisingly little it will cost to put your steam consumption on a sound accounting basis. Also ask for Bulletin 35-80PR.



Available in seven sizes 250-12,000 lbs. per hour capacity.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 years

and advice. State and local committees made up of key men in labor, industry and vocational training cooperated by coordinating the subjects being filmed.

It is the plan of the Office of Education to build its film program in terms of the specific needs of the training program. The program, which gives educational films an importance they have not received previously, is said to be the greatest step ever taken in visual education.

The training program, it is pointed out, is designed to train for specialized skills, and does not attempt to turn an unskilled worker into a full-fledged worker in short order. Because of this, and since it is upgrading operators into better-paying jobs, the program has received the endorsement of labor.

Production of Electric Energy in Argentina During 1940

Figures just released by the Republic of Argentina show that the majority of the electrical energy produced by this South American nation in 1940 was developed by steam units. Of the total energy generated during the year, 82.9% was produced by steam units, 12.5% by internal-combustion engines, and 4.6% by hydro plants.

The reason for the predonderance of steam-generated energy is seen from a chart of the geographical distribution of producing units. 49.6% or half the electricity developed in the nation is generated in the Federal Capital District of Buenos Aires, which has solely steam plants. To this add another 30.5% generated in the state of Buenos Aires, which surrounds the Federal Capital District, and there is left only 19.9% generated in the other nine states of the country.

Consumption charts of this energy show that 43.8% was used by industrial establishments, 34.2% by homes and commercial buildings, 15.0% by railways, 6.5% by public lighting, and 0.5% for free government services.

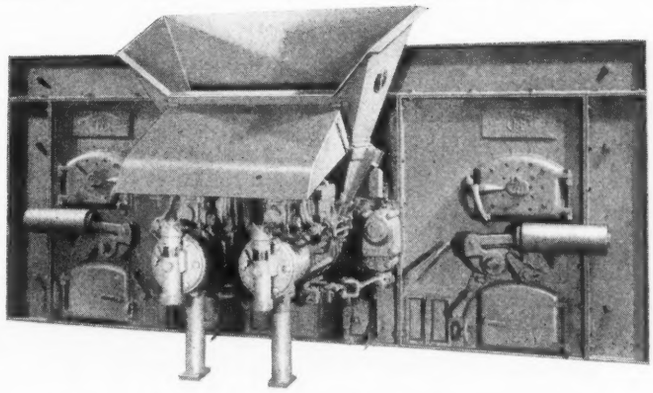
The *Revista Electrotecnica*, from which these figures were obtained, points out the low total generated by hydro units, and promises a substantial increase in development of natural hydroelectric resources during the next few years.

NAPE Entertains

Some 2000 members, relatives and friends of The National Association of

QUALITY

THE POLICY THAT HAS ENDURED FOR A CENTURY 1842 · 1942



"QUALITY", or to produce only the best, has been the policy of the Flynn and Emrich Company from its very inception — 100 years ago.

Today every piece of power plant equipment that bears the "F & E" emblem reflects this wise policy, which, in 1942, is still the cornerstone of sound business practice.

Here, at Flynn and Emrich Company, we firmly believe that the "F & E" Stoker is second to none in efficiency, economy and dependability, and that belief is based on actual performance records in power plants throughout the country.

PRODUCTION begins in the boiler room. In these days, when every man hour counts, a dependable "F & E" Stoker is the best safeguard against boiler room shutdowns.

Look to "F & E" for QUALITY— in workmanship, in engineering advancements and performance.

F&E

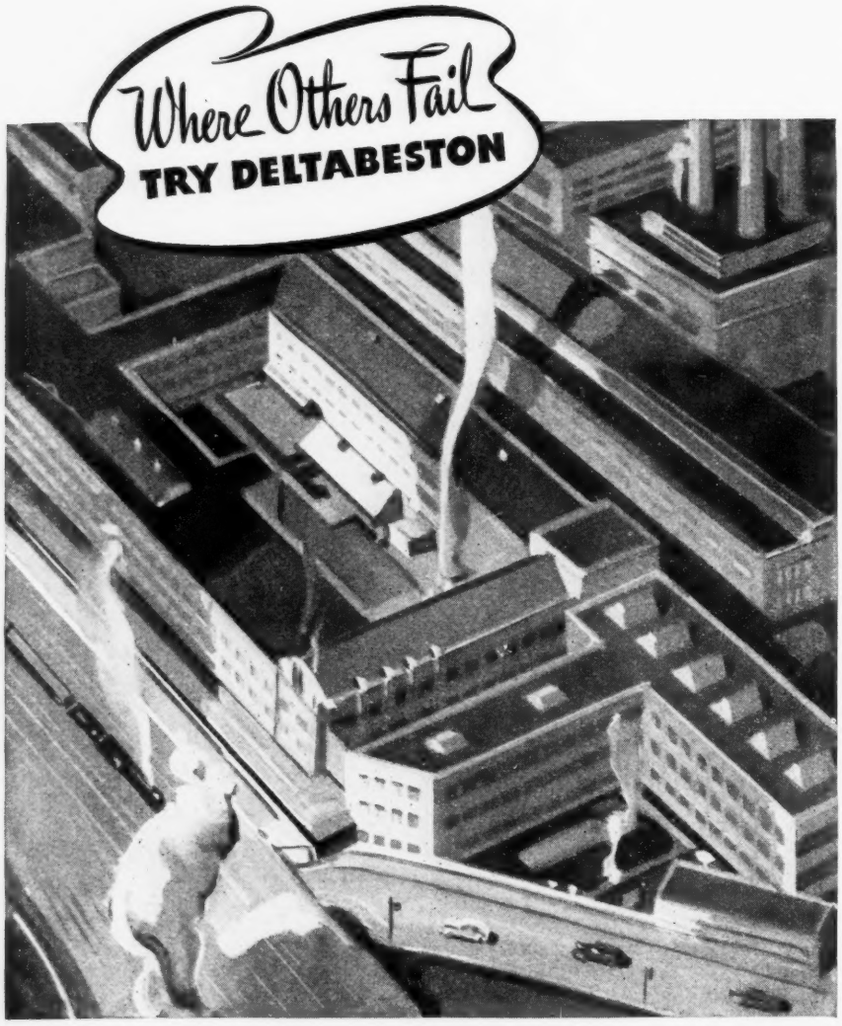
STOKERS

are manufactured and sold by

THE FLYNN & EMRICH CO., BALTO., MD.

Representatives in Principal Cities

Production Assures Victory



Charity Begins At Home

NO SIR—we are not like the farmer who sells all the cream and keeps only the skimmed milk for himself and his family. We in the General Electric Company are very particular about the materials which go into our products. That's why, after exhaustive tests, our engineers selected Deltabeston Asbestos- and Glass-insulated Wires and Cables for so many applications. We use them, just to give a few examples, in Switchboards, Rheostats, Fluorescent Ballasts, Reactance Coils, Street Railways, Bus and MD Motors, Ranges, Hot Water Heaters, and Table Appliances, and in many locations in our plants where other wires and cables would fail.

Deltabeston Wires and Cables are distributed nationally by Graybar Electric Company and all G-E Merchandise Distributors. If you want to know more about these cables, write to Section Y-2522, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

Power Engineers, turned out Jan 17 for the annual entertainment and reception of Stevenson Association No. 44, at the Hotel Riverside-Plaza in New York.

Following a variety entertainment program, including audience-participation numbers, the members passed the remainder of the evening dancing to the music of a well-known orchestra.

Frank W Sanderson is president of No. 44. Members of the arrangement committee were A Perkins, chairman; W Bohlinger, J Dirks, and S S Henderson.

Feedwater Commentary

I just want to convey to you my congratulations on the very fine work on the December 1941 issue of POWER on the Handbook of Feedwater Treatment which you have covered so adequately and which is of very great interest to a large number of our mechanical men who have had a very haphazard knowledge of feedwater treatment.

In glancing over this article, I was interested in your four-fold objectives for feedwater treatment given on Page 1. The fourth objective states that "embrittlement inhibition to avoid cracks between crystals of drum metal requires maintenance of proper balance between sulphates and carbonates in the drum water as recommended by the ASME Boiler Construction Code." At the last meeting of the ASME in New York a group of papers was presented at the Feedwater Section which tend to confirm the growing belief that the maintenance of the ASME sulphate-carbonate ratio is no definite insurance against embrittlement. This is particularly so in the higher pressure ranges. This just illustrates the fact that it is practically impossible to write an article which cannot be criticized.

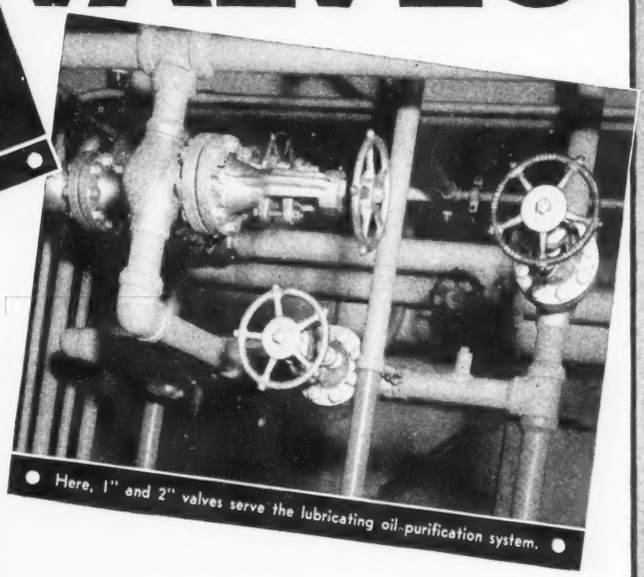
Under the subject "Corrosion" on page 66, you state "thus corrosion can be practically stopped by complete elimination of dissolved gas". We have been following this procedure in all of our plants and pay no attention to the alkalinity of the water. As far as I know, our company is the only one that is doing this, and we have had no tube failures or any signs of corrosion in the boilers since we started this method some sixteen or seventeen years ago.

Jackson, Mich. G C DANIELS
Mech Engr, Commonwealth & Southern Corp

In the line at BURLINGTON STATION

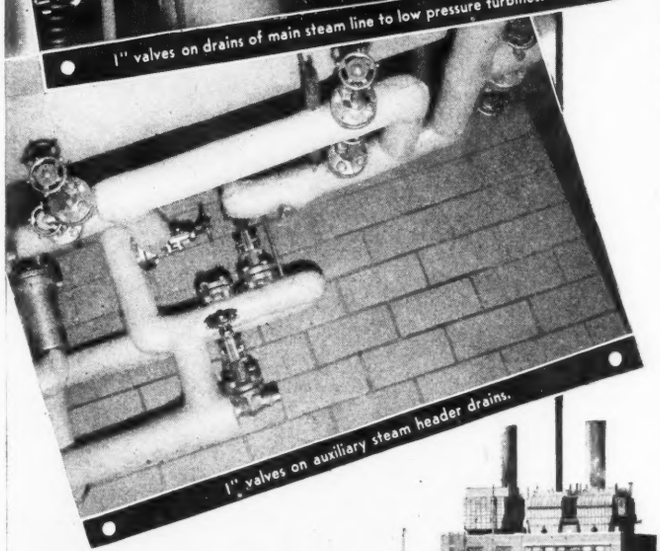
Vogt
DROP FORGED STEEL
Superior VALVES

1" valves on steam coil drain lines of evaporators.



Here, 1" and 2" valves serve the lubricating oil-purification system.

1" valves on drains of main steam line to low pressure turbines.



1" valves on auxiliary steam header drains.

Unit No. 5 at the Burlington Generating Station of the Public Service Electric and Gas Company has recently been placed in service. It consists of two 550,000 lb.-per-hour boilers which supply steam at 1,250 lb. and 950 deg. F., a 125,000-kw. condensing turbine-generator operating at 3,600 rpm., and the necessary auxiliary equipment.

Vogt *drop forged steel* socket weld end valves, as illustrated here, play an important part in the smooth, dependable functioning of this modern power plant.

Catalog F-8 sent upon request.

HENRY VOGT MACHINE COMPANY
Incorporated
LOUISVILLE, KENTUCKY
Branch Offices: New York - Philadelphia - Cleveland - Chicago - Dallas

General view of Burlington Generating Station of the Public Service Electric & Gas Company.

THINGS YOU SHOULD KNOW

if you use pumps!

Things that make a big difference in performance between ROPER "hydraulically balanced" PUMPS and other pumps.

GEARS THAT FLOAT IN OPERATION SAVE YOU TIME AND MONEY! The pumping gears in ROPER "hydraulically balanced" PUMPS have hollow shafts so that internal pressure is equalized at all points. These gears are entirely separate from the drive shaft and are connected only by a sliding joint which permits them to actually "float" in operation. This sliding joint plus a special collar on shaft absorbs any shock or end thrust.

This feature means big savings in time and money for you because "hydraulically balanced" pumps are more efficient, last longer and permit periodic inspection of internal parts without disturbing piping or power unit.

REPLACEABLE BEARINGS GIVE PUMPS LONGER LIFE —The 4 large bearings (two on each side) in ROPER "hydraulically balanced" PUMPS are designed and constructed to withstand severe operating abuses and adequately handle peak loads. These flanged high lead bronze bearings also act as wearplates to protect face and backplate from wear. Can be replaced easily and inexpensively.

ROPER MECHANICAL SEAL REDUCES POWER REQUIREMENTS — Each ROPER "hydraulically balanced" PUMP is regularly equipped with a Roper Mechanical Seal. It saves money by reducing power consumption and keeps leakage to a minmum. Especially desirable where re-packing is not practical — that also saves you time and money.

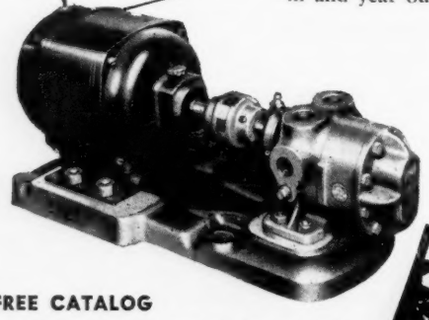
HYDRAULICALLY BALANCED

THIS SEAL appears on every ROPER "hydraulically balanced" PUMP. It means higher efficiency, quieter operation, greater dependability and longer life.

SAVES FLOOR SPACE—ROPER PUMPS are designed to operate at direct motor speeds, thus eliminating gears, belts, etc. . . . saves space, and what plant doesn't need more space?

ALWAYS PRIMED — Once primed and in operation a Roper will always pick up its own prime — ready for instant action.

AS DEPENDABLE AS OLD FAITHFUL — That is the reputation earned by dependable performance year in and year out.



FREE CATALOG

Send for your free copy of Catalog 944 It contains complete information on 16 different sizes of Roper Pumps. Learn how you can save money and trouble on your pumping problems.

★

THIS HAPPENED FROM COAST TO COAST

United Air Lines say this about Roper Pumps on their refueling tank trucks . . . "first, they are SPEEDY and DEPENDABLE . . . second, their QUIET operation makes them ideal for refueling sleeper planes . . . third, they are the most EFFICIENT we have ever used . . ."

★

THIS HAPPENED IN ILLINOIS

A manufacturing plant was using five pumping outfits . . . average life of each pump, 16 hours and cost per pump, $16.65. Roper analyzed the problem and made recommendations. RESULT — average life of pump was s-t-r-e-t-c-h-e-d to 13 months. Net saving to customer in 13 months — $29,690.00.

★

THIS HAPPENED IN OHIO

Weaver-Wall Co., Cleveland, use Roper Pumps for pumping hot asphalt at temperatures up to 400°, eight hours per day in the winter, twenty-four in the summer. Some test! But Roper Rotary Pumps endured for more than 12 years.

ROPER *Rotary* PUMPS

GEO. D. ROPER CORP. ★ ★ ★ ROCKFORD, ILLINOIS

83-Mile Pipeline Welded in 30 Days

A new 83-mile, 10¾-inch pipeline to relieve the Pacific Coast tanker shortage by transporting oil from Ventura to Wilmington, (Los Angeles), California, for production of vitally-needed high-test aviation gasoline was just recently completed in the record time of 30 days by use of arc welded construction. Fig. 1 shows the last joint being welded by Sidney Belither, Board Chairman of Shell Oil Company, the owner.

Fig. 1—Final joint of the 83-mile Ventura-Wilmington oil pipeline being welded by Sidney Belither, Board Chairman of the Shell Oil Company

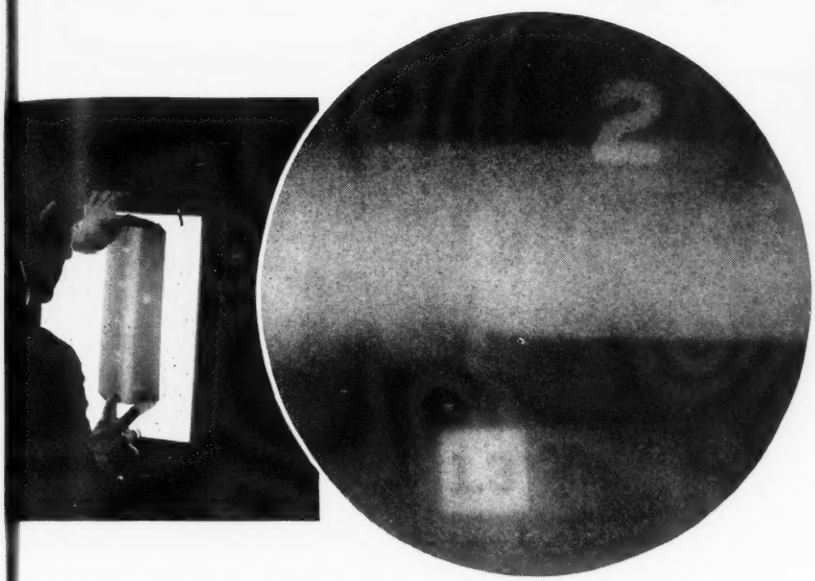
Built for the Shell Oil Company by the Macco Robertson Construction Company of Clearwater at a cost of $2,000,000 the line was "stove-piped", every joint being individually arc welded. Joints were welded in three beads by the shielded-arc process using equipment supplied by The Lincoln Electric Company, Cleveland, Ohio.

There were 435,000 feet of pipe weighing 9000 tons. An average of 12,500 feet of pipe were laid daily, indicating the speed of construction.

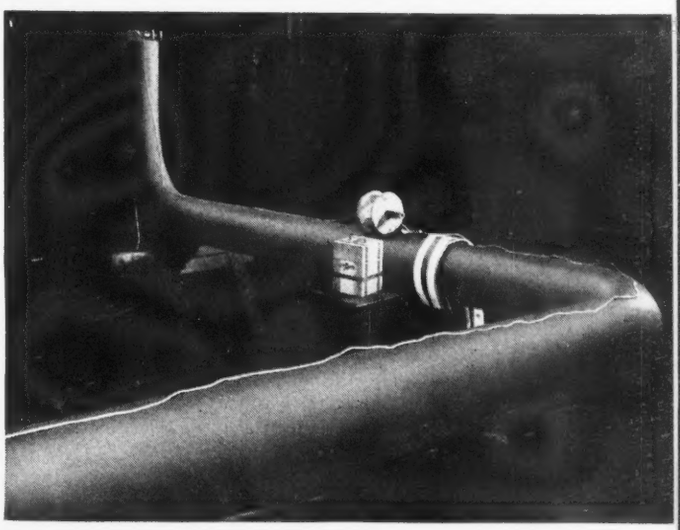
Fig. 2—General view of the Shell Oil Company's 83-mile 10¾ inch oil line constructed in 30 days by arc welding

PROMOTING *Greater Safety*
IN HIGH PRESSURE, HIGH TEMPERATURE PIPING

Gama-Ray Inspection of Welds at **PITTSBURGH PIPING** Provides Positive Proof of Correct Welding



Powerful Gamma-Rays eminating from radium placed on the inside of the piping, pierce through the thick metal and expose a special photographic film wrapped around the outside of the weld being investigated. Any defects in the weld metal and adjoining area of the piping can be easily traced on either a negative or a positive print, as illustrated above.

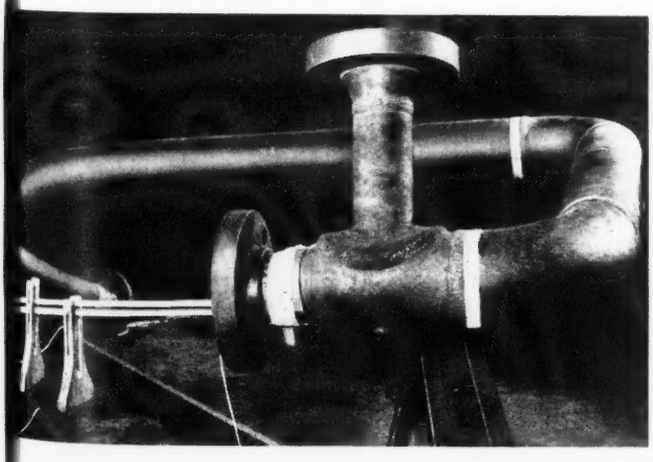


The radium is contained in a silver capsule encased in duralumin which is placed in the center of the wooden fixture shown on top of the pipe. The fixture is pulled centrally through the pipe until it is transversely in-line with the weld, where the Gamma-Rays expose the negatives placed around the outside weld area.

THE welding of high pressure high temperature piping requires modern shop equipment, proper procedure and highly trained men.

Pittsburgh Piping has carefully worked out the correct welding procedure for each type of metal and has skilled welders who must prove their ability by specified code tests. Their workmanship is further checked by Gamma-Ray Radiography of all shop and field welds where required by codes or customer's specifications.

Radiography by means of radium provides the most practical method of non-destructive testing of pipe welds. At Pittsburgh Piping, Radiography is used beyond the requirements of codes and specifications to periodically check the performance of welders, so as to further insure the maintenance of uniform, high quality piping fabrication.



Making a Gamma-Ray inspection of a flange weld. The white bands visible around two other welds contain identification numbers which show on the exposed film.

PITTSBURGH PIPING & EQUIPMENT CO.
10 FORTY-THIRD STREET **PITTSBURGH, PA.**

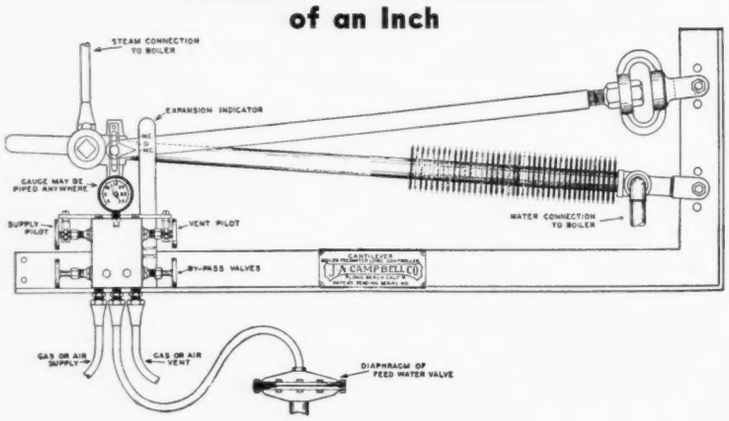
Woolworth Bldg., New York · Occidental Bldg., Indianapolis · Peoples Gas Bldg., Chicago · Union Guardian Bldg., Detroit
Public Sq. Bldg., Cleveland · 10 High St., Boston · Liberty Life Bldg., Charlotte · 525 Market St., San Francisco

Pittsburgh Piping

CAMPBELL SUPERSENSITIVE

BOILER WATER LEVEL CONTROLLER

Accurate to the Fraction of an Inch



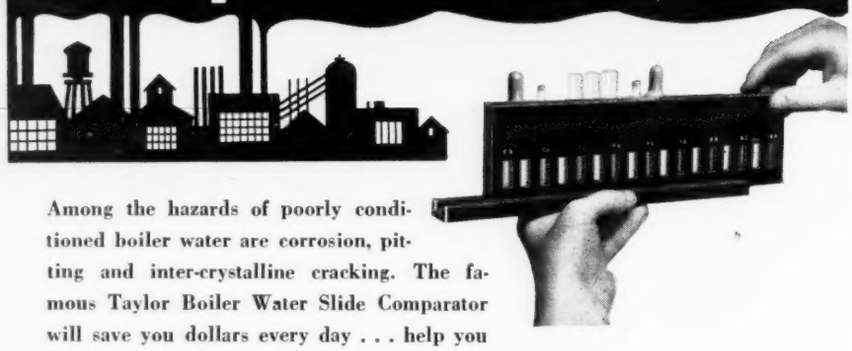
Cantilever principle increases sensitivity of valve motivation six times. Radiating fins on thermal tube double efficiency. Globe valve insures sensitive throttling, unrestricted flow, minimizes valve stem leakage and "liming up." Smooth, rapid and practically frictionless valve movement. Controller may be attached to either side of boiler. Cone bearings at pivotal points eliminate lost motion and form rigid triangle. Made also in Pilot Type for remote control. No floats. No complicated parts. Fully tested in service. Approved by A.S.M.E. and American Bureau of Shipping. Ask for Catalog.

Some selected territories for Distributors are available

J. A. CAMPBELL CO.

649 E. Wardlow Road, Long Beach, California

Control pH and Phosphates in your BOILER WATER and you Control PRODUCTION!



Among the hazards of poorly conditioned boiler water are corrosion, pitting and inter-crystalline cracking. The famous Taylor Boiler Water Slide Comparator will save you dollars every day . . . help you cut down on boiler repairs and costly descaling shut-downs. Simplicity of determination, accuracy, speed and low cost are features that have made Taylor pH Slide Comparators standard equipment in prominent industrial plants. Write today for new 80-page booklet, "Modern pH and Chlorine Control", or see your dealer.

All Taylor Color Standards carry an unlimited guarantee against fading.

W. A. TAYLOR AND CO.

YORK & ROGERS FORGE RDS. • BALTO., MD.

Extreme hilly terrain—the line, (See Fig. 2), is through the Santa Monica Mountains at an elevation varying between 950 and 1700 ft—required bending the pipes over hills, around bends and into valleys. Slopes of 60 degrees were not unusual. Bending was done with the pipe cold, but in many instances with the weld still warm.

The new line will deliver 22,000 barrels of oil daily to the Wilmington refinery of Shell Oil Company and increases the company's expenditures in California pipe lines to $12,000,000.

Power Classes

William Engelmann, test engineer for the City of Cleveland, is now teaching a class in power engineering at the meeting hall of the local union. Sessions are held four evenings a week and on Saturday and Sunday afternoons. Altogether, the term requires 576 hours of classroom work and an equal number of home-study hours. About 250 operating men from Cleveland and vicinity have signed up for this course.

Reversed Captions

Through an error, the captions describing the embrittlement detectors on page 99 of POWER's Mid December issue were reversed. The correct caption for Fig. 1 is "Field unit for cracking tests designed by Schroeder, Bureau of Mines, for boiler blowdown lines" and Fig. 2 should read "Laboratory-type detector developed by Straub and his associates at the University of Illinois"

Brief Reviews

FEDERAL WAGE AND HOUR LAW—1941. *By Arthur W Nevins, attorney. Published by National Foreman's Institute, Deep River, Conn. 58 pages, leatherette bound. Price $1.50.* Manual for executives, department heads and supervisors. Covers completely the Fair Labor Standards Act of 1938, known as the Federal Wage and Hour Law. In question and answer form, it includes chapters on covered employees, exemptions, minimum wages, working time and overtime, records, child labor and enforcement.

THERMODYNAMICS OF BOILER FEEDING—*by Igor J Karrassik. Published by the Hydraulic Institute, 90 West St,*

ALL of the control instruments are located on this centralized canopy lighted panel, not scattered all over the boiler room or hung on the sides of the boiler. Small cut, lower right shows rear of panel with connections to power units. Electric operation makes for neatness, simplicity and ease of understanding.

Electric

ALL THE WAY!

HAYS

CENTRALIZED AUTOMATIC COMBUSTION CONTROL

Stokers, pulverizers, fans and oil burners are more and more becoming electrically driven. It is entirely logical therefore that an automatic combustion control system be operated electrically. Hays *centralized* control is operated entirely by electricity, employing enclosed mercury switches for the sensitive contacts, thus assuring freedom from trouble due to moisture, dust, dirt and chattering. Electric operation also simplifies installation and maintenance. Adjustments are made direct and are not dependent upon air pressures, oil pressures, and the numerous valve mechanisms made necessary by non-electric designs. When considering automatic combustion control buy for tomorrow—buy electric—buy HAYS.

HAYS

Automatic

COMBUSTION CONTROL

THE MODERN SYSTEM—*it's Electric!*

THE HAYS CORPORATION • • • MICHIGAN CITY, INDIANA

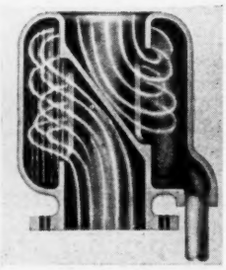
In more than
12,000 Plants
COCHRANE
MULTIPORT
RELIEF VALVE

Cochrane Multiport Back Pressure Relief Valve with front and back plates removed.

Successful operation of the Cochrane Multiport Valve in more than 12,000 plants is a sure guarantee of its continuously reliable operation. This continuous operation is insured by the multiport principle — a number of small discs instead of one large disc, eliminating the sticking, jamming and freezing common to single-disc valves in the control of atmospheric relief, back pressure, etc.

Call your Cochrane representative or write for further details.

COCHRANE Exhaust Head



Designed to separate condensate and oil from steam discharged to atmosphere and thereby prevent raining of water and oily condensate on the roof, Cochrane Exhaust Heads incorporate a highly efficient free-flowing baffle type construction and an exceptionally large port area which minimizes back pressure. Write for further details.

COCHRANE CORPORATION

COCHRANE

Cochrane Corp., 3106 N. 17th St., Phila., Pa.
Please send me copies of your publications on Condensate Drainage
Name.....
Firm.....
Address.....
City..... State.....

New York, N. Y. 40 pages, illustrated with line diagrams, paper bound. Price $1.50. This booklet is the first-prize-winning essay in the First Annual Engineering Essay Contest, held last year by the Institute. Some of the specific problems covered are: description of feed cycles in general, discussion of pumping power and mechanical problems with relation to feedwater temperature, analysis of temperature rise in boiler feed pumps and discussion of minimum permissible capacities. Parts of the essay appeared in the March and May 1941 issues of POWER.

DESIGNED FOR POWER—*published by the Burns & McDonnell Engrg. Co, 48 pages, paper bound. No price listed.* Object of this brochure is to present a clear picture of how municipal governments are meeting public demands and how the Burns & McDonnell engineering organization supplies a vital service. Deals exclusively with municipalities in design, construction and operation of water works, sewage systems and electric utilities. Presents a few representative modern power plants, which give an interesting variation in the problems of power engineering.

PRACTICAL LESSONS IN ARC WELDING —3rd Edition, 7th printing—1941, *by W J Chaffee, published by Hobart Brothers Co, Troy, Ohio, 100 pages, 77 illustrations, paper cover. Price postpaid $.50. Special edition in Spanish $2.00.* This arc-welding book offers students, instructors, engineers and executives practical arc-welding data and lessons. Patterned after the course in the Hobart Trade School, this book leads the student easily through all the fundamental stages of arc welding. Covers 42 complete arc-welding lessons.

TVA Capacity Now 1,043,670 kw

The Tennessee Valley Authority, since its establishment in 1933, has, among its activities, developed an electric generating and transmission system which now has a capacity of 1,043,670 kw in 64 generating units, a one-hour peak load of about 860,000 kw and a monthly output of 520,000,000 kwhr, according to a paper presented by R A Hopkins at the Southern District meeting of the American Institute of Electrical Engineers.

The original generating facilities taken over by the Authority in the fall of 1933 consisted of the Wilson hydro and steam plants both built at Muscle Shoals, Alabama, by the United States Government during 1918 to 1925

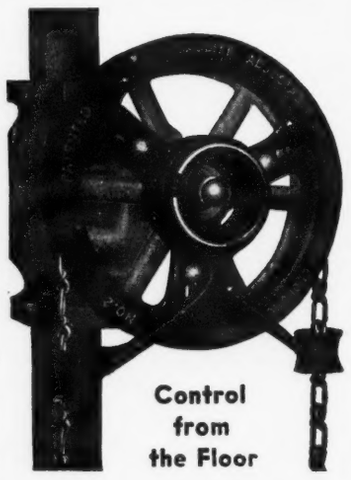
WHEN you consider the cost of low pressure air at about 1 H.P. per 100 C.F.M., you will quickly realize the economy of Rockwell Blast Gates—the kind that are air-tight, non-chattering and that provide better control of your air lines.

Light, strong, carefully machined to close air-tight, Rockwell Blast Gates are available in all types. They can be made up in aluminum, monel, bronze or other alloy metals to meet your requirements.

Write for catalog 4020, W. S. Rockwell Co., 50 Church Street, New York.

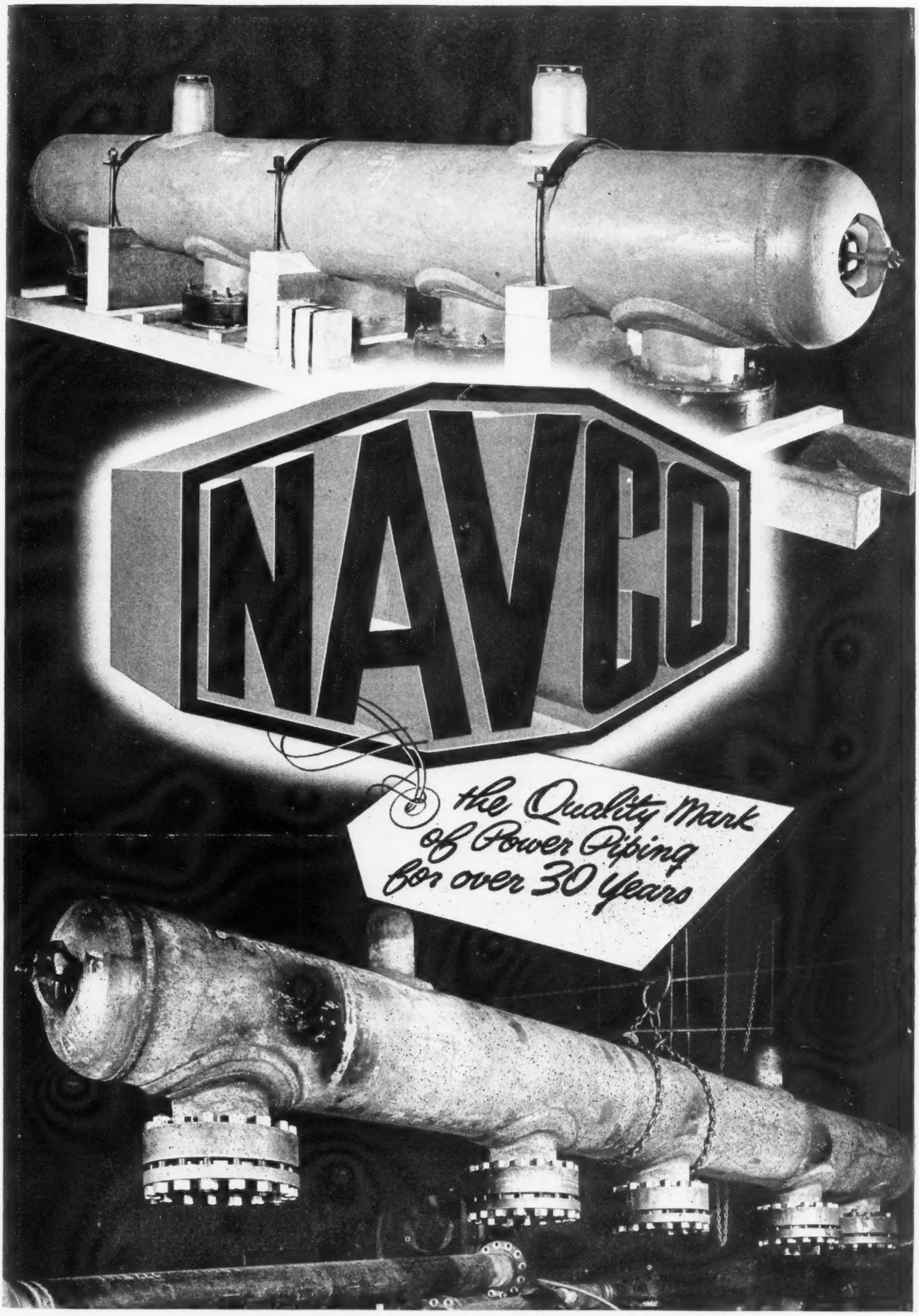
★ Rockwell ★
BLAST GATES

Make Your Overhead Valves SAFE And Easy to Reach---

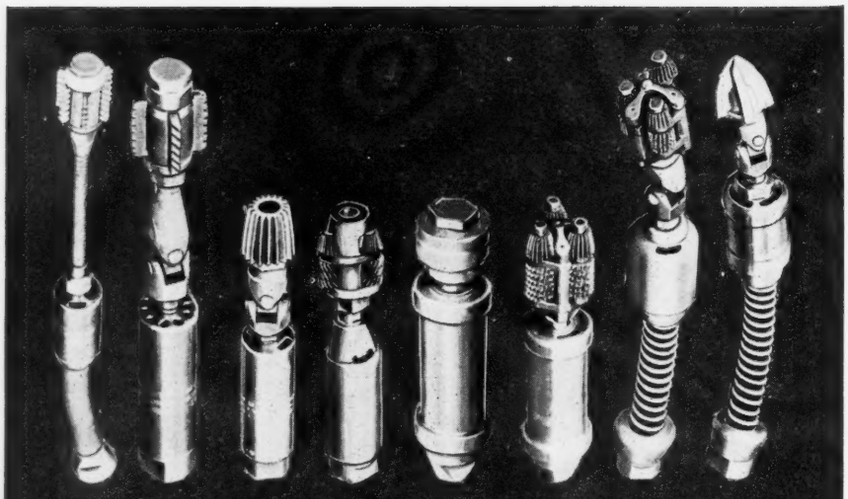


With the Babbitt Rim for Valves you eliminate danger and banish the step-ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.



NATIONAL VALVE & MANUFACTURING COMPANY — PITTSBURGH, PENNA.



MAXIMUM BOILER EFFICIENCY IS MORE ESSENTIAL THAN EVER

Now that we are at war, it is more essential than ever before to see that every boiler in the country is operated at its maximum efficiency. This will save precious fuel, decrease delaying shutdowns, and increase vital production of the planes, ships, tanks, guns and other supplies essential to victory.

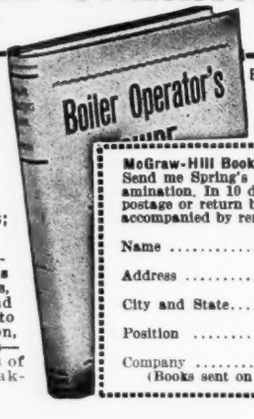
Wilson Tube Cleaners clean faster, and better and thus *reduce* tube cleaning time and *increase* the time a boiler can operate before another cleaning is necessary.

Use Wilson Tube Cleaners and Wilson accessories for *quickly* and *thoroughly* removing any fouling deposit from straight or curved ferrous or non-ferrous tubes of large or small diameter.

Write for the name of our representative nearest to you or for a copy of our thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

THIS NEW **BOILER OPERATOR'S GUIDE**
. . . can mean money to you!



JUST OUT! Here's information of the most priceless sort for you — whether you want to improve your ability as an inspector or to utilize effective inspection methods in the more efficient, safer operation and upkeep of your own boilers.

Helps you meet everyday problems; Prepares you for license exams

With hundreds of typical examination questions and answers as well as complete instructions, this book presents fully and plainly the things you want to know about proper installation, operation, and care of boilers—the things that prevent dollars of loss in reduced efficiency, breakdown, or even accident.

By H. M. Spring, Jr.
353 pages, 6 x 9
241 illustrations
$3.00

EXAMINE A COPY FOR 10 DAYS ON APPROVAL

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C.
Send me Spring's Boiler Operator's Guide for 10 days' examination. In 10 days I will send you $3.00, plus few cents postage or return book postpaid. (We pay postage on orders accompanied by remittance.)

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and totaling 244,000 kw in generating capacity. During subsequent years the Authority has acquired and leased from private utilities previously operating in the Tennessee Valley area five hydro plants and four steam plants, totaling 285,770 kw, with transmission lines.

Up to the present time the Authority has built and put into operation six new hydro plants and extensions to existing hydro plants, totaling 513,900 kw in 15 generating units, with transmission lines. The Authority now has under construction six new hydro plants, one new steam plant and extensions to two existing hydro plants, totaling 969,200 kw in 29 generating units, with transmission lines. The system as now operating and under construction, including the future generating units definitely provided for, will have a total capacity of 2,578,170 kw in 107 generating units.

The voltage of the main transmission system, nominally 154 kv, was chosen because study indicated that this voltage would be adequate for transmission purposes within the Tennessee River Basin, and also because 154 kv was already established at Muscle Shoals. The 500-mile transmission line connecting Norris, Watts Bar, Wheeler, Wilson, and Pickwick Dams and the Memphis substations has, however, been designed for 220-kv operation to provide the higher transmission voltage if it is required in the future, but is now operated at 154,000 volts. All new generating stations have been connected to the 154-kv transmission system.

The lower voltages, 110, 66, and 44 kv, were also existing in the Valley. At Norris, Pickwick, and Guntersville, auto-transformers are installed to supply 110-kv transmission. At Chickamauga 3-winding step-up transformers are provided to serve the 44-kv transmission system of the city of Chattanooga, both from the generators and from the 154-kv system. As a rule, step-down points have been located near load centers and not a generating stations, but in every case where the most economical step-down location is near a generating station, the economies of centralized station attendance have been secured by combining the step-down and generating stations.

Two general designs of generating station arrangement have been developed to suit the two general classes of sites: The *tributary development* is illustrated by Norris, Hiwassee, and Cherokee. The *main river* development is illustrated by Wheeler, Pickwick, Guntersville, Chickamauga, Watts Bar, Kentucky, and Fort Loudoun.

SPEED UP PRINT PRODUCTION ...CUT PRODUCTION COSTS

WHEN YOUR PRINT MAKING is complete—all purpose — economical — that's when you increase print production — reduce print making costs.

With the Ozalid Process your prints are made at savings in time—labor—materials—*because* Ozalid is the *only* complete reproduction process.

Positive-type whiteprints having blue, black or maroon lines are made simply by using Ozalid sensitized materials in any of its whiteprint machines. They are printed and *dry* developed in one compact unit.

This process is time saving *because* prints are made in two easy steps, exposure and dry development . . . the finished prints are dry, ready for instant use . . . duplicate originals are made quickly just as whiteprints . . . changes, additions and corrections can be easily made on transparencies without altering the original drawing.

Production costs are cut *because* only one person is needed to operate any Ozalid machine . . . the use of cut sheets eliminates trimming waste . . . and uniform printing qualities of Ozalid materials lessen the possibility of over-exposure and subsequent waste of materials.

Write today for information describing how easily you can make prints at great saving with the Ozalid process.

SPECIFY *Ozalid* WHITEPRINTS

BASIC FACTS ABOUT PRINT MAKING YOU SHOULD KNOW

OZALID STANDARD WHITEPRINTS OFFER A VARIETY OF EITHER BLUE, BLACK OR MAROON LINES ON A WHITE BACKGROUND . . . whereas blue prints offer no choice of color.

This variety of Ozalid color lines enables you to assign an identifying color to the office, another to the field, another for filing . . . distinguish checked prints from unchecked prints . . . lessen the possibility of errors.

These Whiteprints are permanent, true-to-scale of the original, and will not wrinkle or curl. They are easier to read, write on and check than negative prints.

★

This is the third of a series of facts on modern print making. Watch for Fact No. 4.

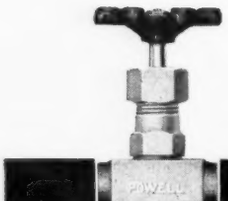
OZALID PRODUCTS DIVISION
GENERAL ANILINE & FILM CORPORATION
JOHNSON CITY, N.Y.
Ozalid in Canada • HUGHES OWEN CO. LTD., Montreal

BETWEEN *these* EXTREMES

From the smallest to the largest valve in general use today the Powell Line extends. Between these extremes is a great assortment of valves, each designed and built to meet a certain special requirement of American industry.

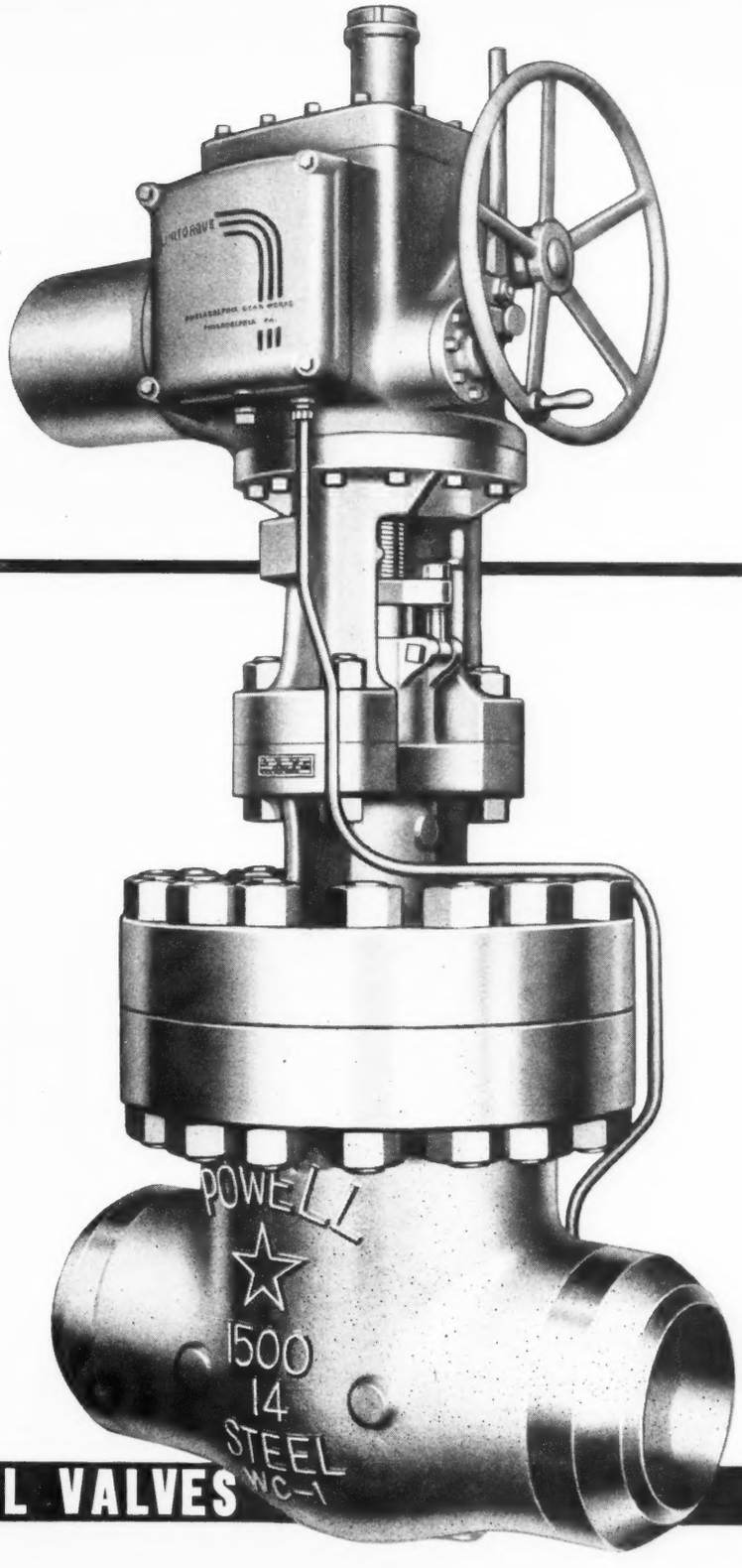
Behind this line is a corps of highly trained research engineers with a vast array of up-to-the-minute laboratory equipment ready and able to work out the answers to new valve problems as they arise. These problems do arise with ever-increasing frequency as industrial advances take form. As each one is solved the answer takes its place in the Powell Line — and the Powell Research Engineering staff makes ready for the solution of the next one. Thus the Powell Line was built and thus it will continue to grow, in step with the inevitable progress of Industrial America.

THE WM. POWELL CO., Cincinnati, Ohio



POWELL VALVES POWELL VALVES POWELL VA

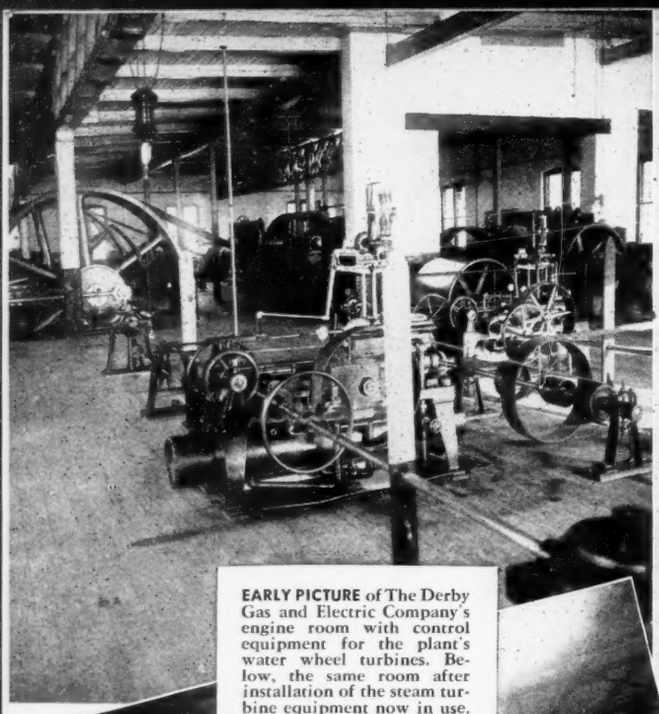
POWELL

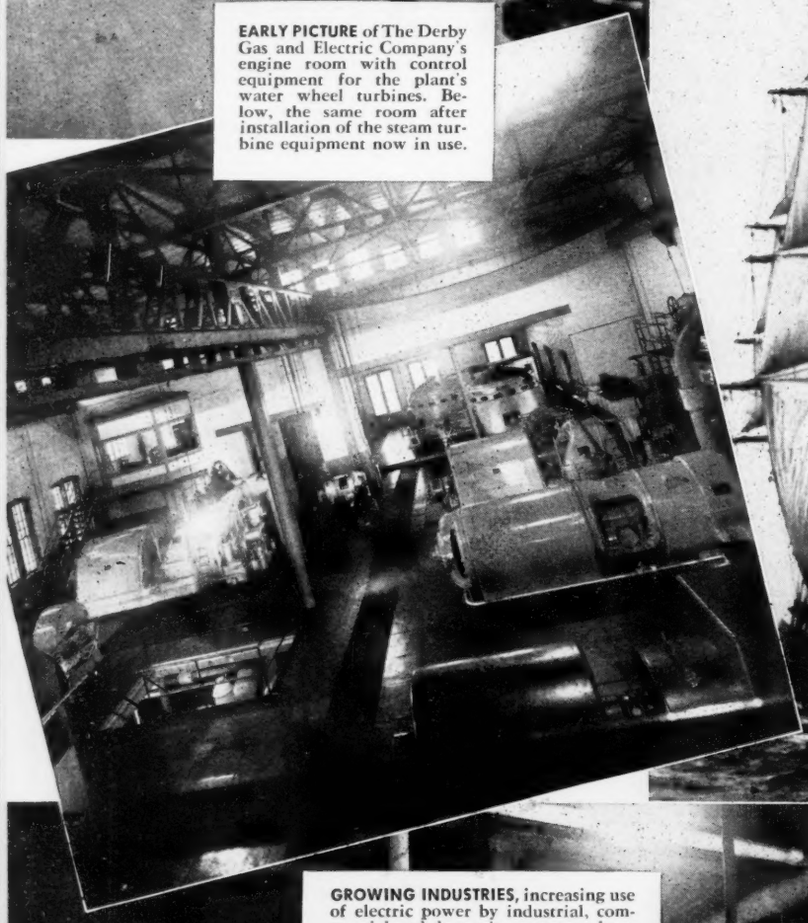


The small valve shown is a ⅛" bar stock needle globe valve for instrument control and similar service. It is available in carbon steel, stainless steel and other alloys. The large valve is a 14" class 1500 lb. cast steel gate valve for operation on 920°F. steam at approximately 1500 lbs. working pressure. It is powered with Limitorque spring compensated motor operator. Between these extremes of size and design is the Powell Line.

ELL VALVES POWELL VALVES POWELL

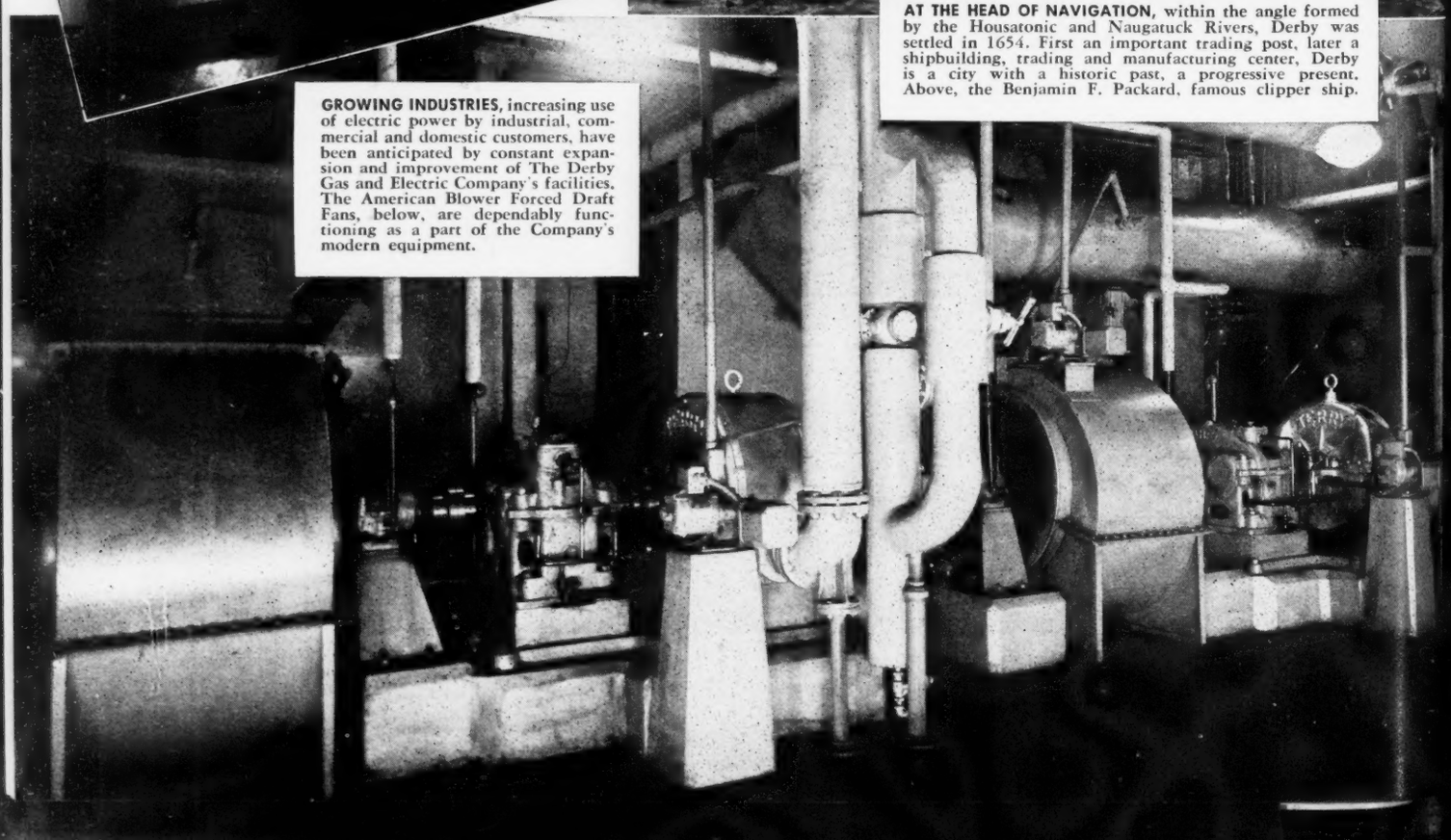
VALVES





EARLY PICTURE of The Derby Gas and Electric Company's engine room with control equipment for the plant's water wheel turbines. Below, the same room after installation of the steam turbine equipment now in use.

AT THE HEAD OF NAVIGATION, within the angle formed by the Housatonic and Naugatuck Rivers, Derby was settled in 1654. First an important trading post, later a shipbuilding, trading and manufacturing center, Derby is a city with a historic past, a progressive present. Above, the Benjamin F. Packard, famous clipper ship.



GROWING INDUSTRIES, increasing use of electric power by industrial, commercial and domestic customers, have been anticipated by constant expansion and improvement of The Derby Gas and Electric Company's facilities. The American Blower Forced Draft Fans, below, are dependably functioning as a part of the Company's modern equipment.

Smooth Sailing

at Derby, Connecticut!

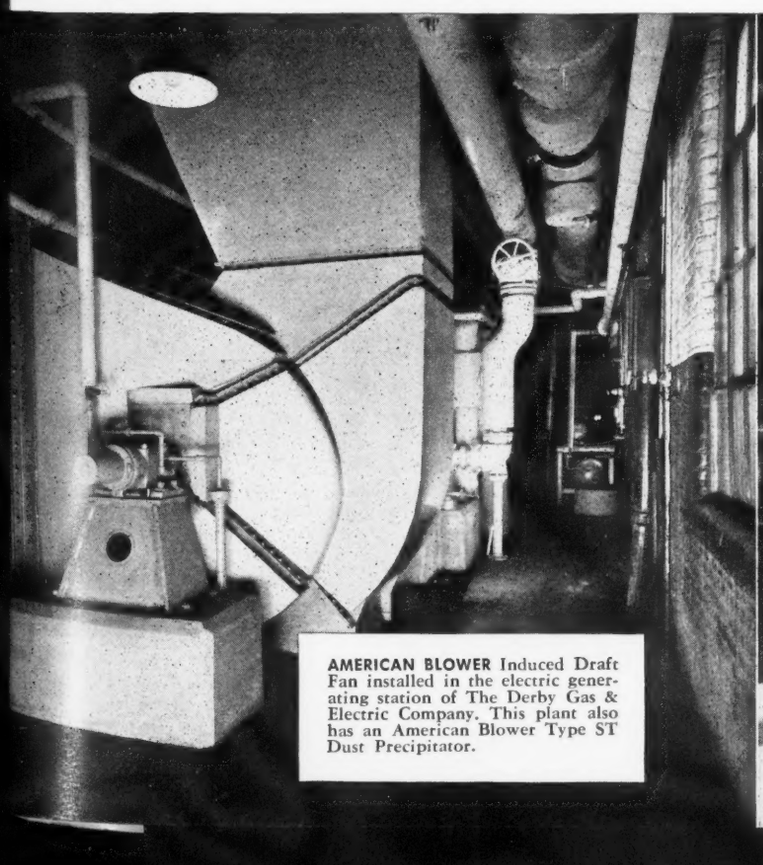
THE DERBY GAS AND ELECTRIC COMPANY'S new office building, above. The Company also supplies electric power for Ansonia and Shelton, Connecticut. Progress in power goes hand in hand in progress in the community!

Long before the American Revolution, Derby, Connecticut, was a shipbuilding center, and great sailing vessels in the West Indies trade made the Derby Docks a regular port of call. During the intervening years, it's been "smooth sailing" at Derby. Today, historic Derby is marching ahead with America to new achievements in fast paced industrial production. The city's land and water transportation facilities are a big asset, as always. Of importance, too, are the modern facilities of The Derby Gas and Electric Company . . . bulwarks of democracy, bastions of liberty are located all over the highways and byways of America. And in each of these important centers, just as in Derby, Connecticut, you will invariably find American Blower Forced and Induced Draft Fans, Fluid Drives and Dust Precipitators doing their part, and doing it well.

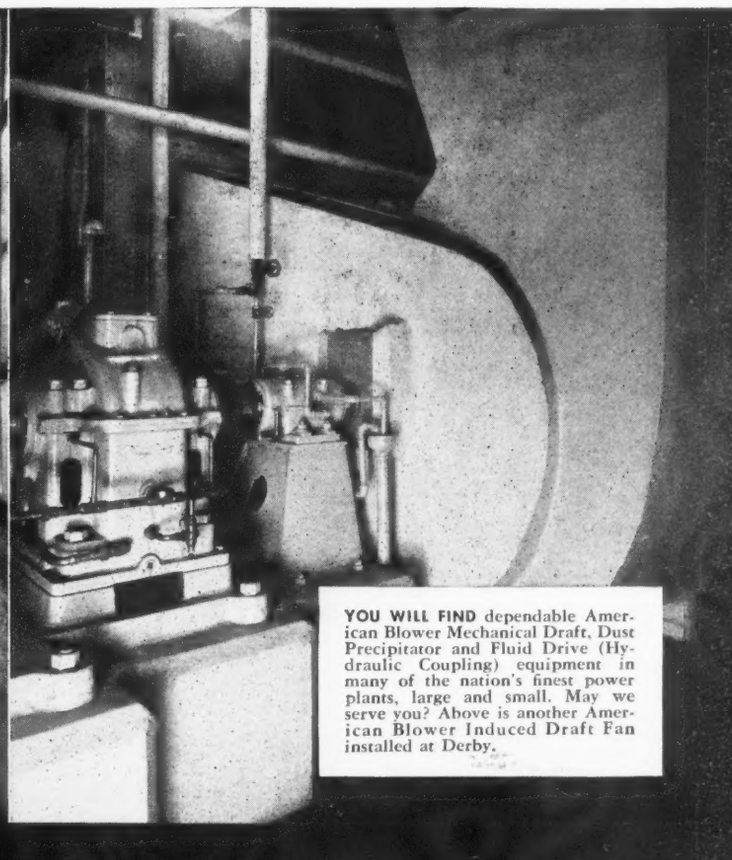
MECH. DRAFT · AIR CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, Detroit, Michigan
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO
Division of American Radiator and Standard Sanitary Corporation



AMERICAN BLOWER Induced Draft Fan installed in the electric generating station of The Derby Gas & Electric Company. This plant also has an American Blower Type ST Dust Precipitator.



YOU WILL FIND dependable American Blower Mechanical Draft, Dust Precipitator and Fluid Drive (Hydraulic Coupling) equipment in many of the nation's finest power plants, large and small. May we serve you? Above is another American Blower Induced Draft Fan installed at Derby.

Sloan Flush Valves?
take

Rockefeller Center

for example

ROCKEFELLER CENTER, probably the largest real estate development in recent history, stands as both a monument to the genius of the late John D. Rockefeller and a symbol of American enterprise. Its fourteen buildings house more than 25,000 tenants and accommodate over 100,000 visitors daily. Its 5,000,000 square feet of floor space afford services ranging from the famous Music Hall with a seating capacity of 6,200 to twenty-four restaurants, eleven foreign consulates, the press and radio center of the world, and schools which teach everything from shorthand to dancing.

This hundred million dollar project is completely Sloan equipped. Why should this property, in common with literally thousands of other large companies and institutions, give such recognition to Sloan Flush Valves? Simply because Sloan Flush Valves give the greatest dollar value.

Why SLOAN *Flush* VALVES?

THEY SAVE WATER. Because of the accuracy and permanence of adjustment Sloan Valves save their owners water *all* of the time. And Saved water is saved money—not only in reduced consumption of water but in reduced pumping and man-power costs.

THEY REDUCE MAINTENANCE EXPENSE. Sloan Flush Valves cost but ½¢ to 1½¢ per valve per year to maintain. Entire installations in service for years without being touched are constantly reported.

THEY SAVE REPLACEMENT. Sloan Valve durability may be verified in *your* locality. Installations 15, 20 and 25 years old are common to every section of the country and every type of building.

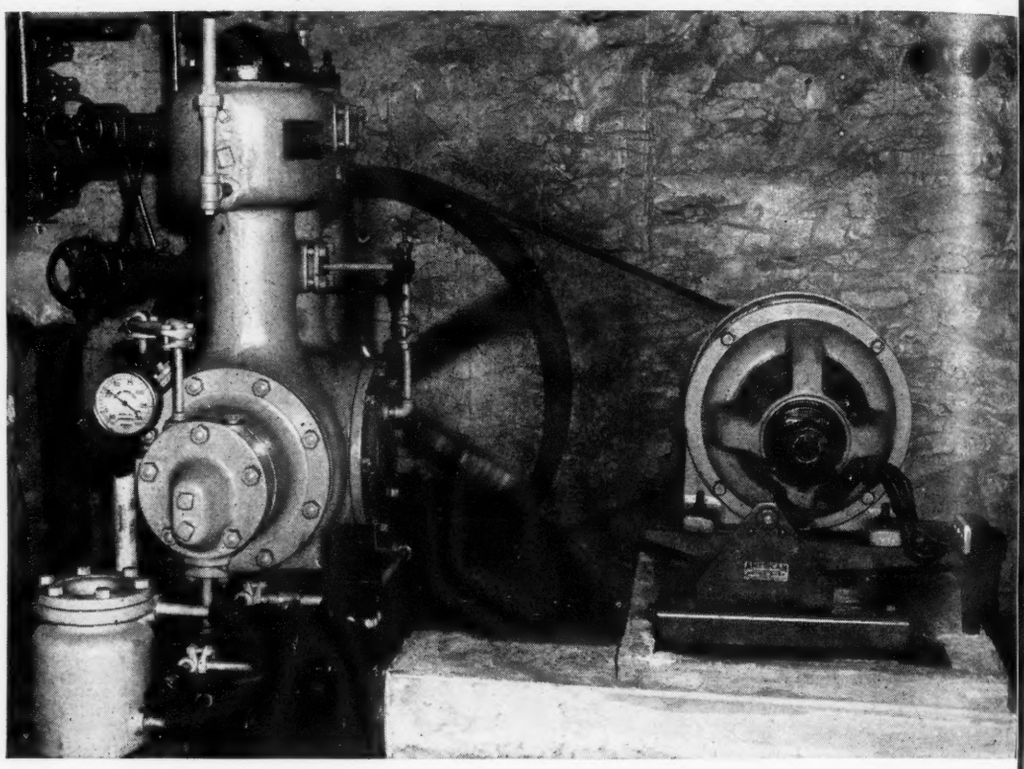
Aerial Photo by Fairchild Aerial Surveys, Inc.

that's why **in office buildings, schools, hospitals, hotels, institutions, factories, apartments or public buildings, the vast majority of flush valves are Sloan. Indeed, there are more Sloan Flush Valves sold than all other makes combined.**

SLOAN VALVE COMPANY, 4300 W. LAKE STREET • CHICAGO

SLOAN *Flush* VALVES

AMERICAN



Econ-O-Matic Drives Mean Automatic Economy

American Econ-O-Matic* Flat-Belt Drive

"Wins Its Letter" at Cornell with a 67% Saving in Operating Cost!

"Far above Cayuga's waters", Cornell maintenance men put a problem up to the University's engineers.

Problem: A compressor drive with an idler was slipping badly . . . belt wear was excessive.

Solution: Cornell engineers installed an American Econ-O-Matic Flat-Belt Drive, with the unique American Motor Base that gives automatic tension control. Thus they eliminated the idler.

Result: Savings of 67% in operating cost—because:

1. Belt slip is eliminated.
2. Belt wear is reduced.
3. Increased bearing life.
4. Operation is quieter.
5. Compressor and drive are operating under load for shorter intervals.
6. Fewer man hours of maintenance are needed . . . with automatic tension control replacing manual adjustments.
7. Cooling efficiency of compressor is vastly improved.

Nine additional American Econ-O-Matic Drives have been installed at Cornell University, Ithaca, N. Y.

What You Can Expect from American Econ-O-Matic Drives

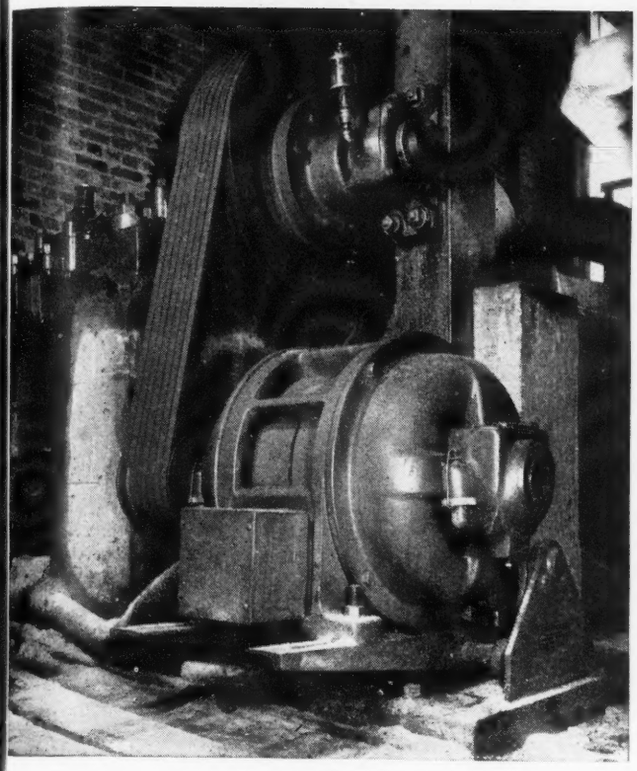
- Increased production because correct RPM level is sustained . . . no belt slip.
- Low first cost quickly saved in reduced power consumption.
- Man hours and materials required for maintenance reduced up to 75%.
- Belt life increased by an average of 100%.
- Bearing pressure reduced by an average of 50%.

Let our engineers prove these economies to you!

THE American

4242 WISSAHICKON AVENUE

ECON-O-MATIC* DRIVES



AMERICAN *Drive Selection Service*

HELP WANTED

on Short-Center Drive Problems? Want the quickest and most efficient answer? Call for AMERICAN DRIVE SELECTION SERVICE. Our engineers and distributors are installing both Flat-Belt and V-Belt Drives every day in the year. They know which type is best suited for each operating condition. Send us your problem *today!*

American Econ-O-Matic* V-Belt Drive—

Saved over $1,000 in 3 Years for Metal Stampings Manufacturer!

At the plant of a leading metal fabricator, a large hydraulic baling machine was really expensive to drive . . . until American Pulley engineers were called into the picture.

Problem: To eliminate frequent shaft and coupling breakage on a direct-connected motor driving the baling machine; motor was started directly across the line. *Former equipment* included a 50 HP, 680 RPM motor connected to driving shaft of the baling machine by a flexible coupling and a clutch.

Recommendation: American Pulley engineers suggested that the machine be driven by a high-speed motor and an American **Econ-O-Matic V-Belt Drive.** Thus the clutch and coupling were entirely eliminated.

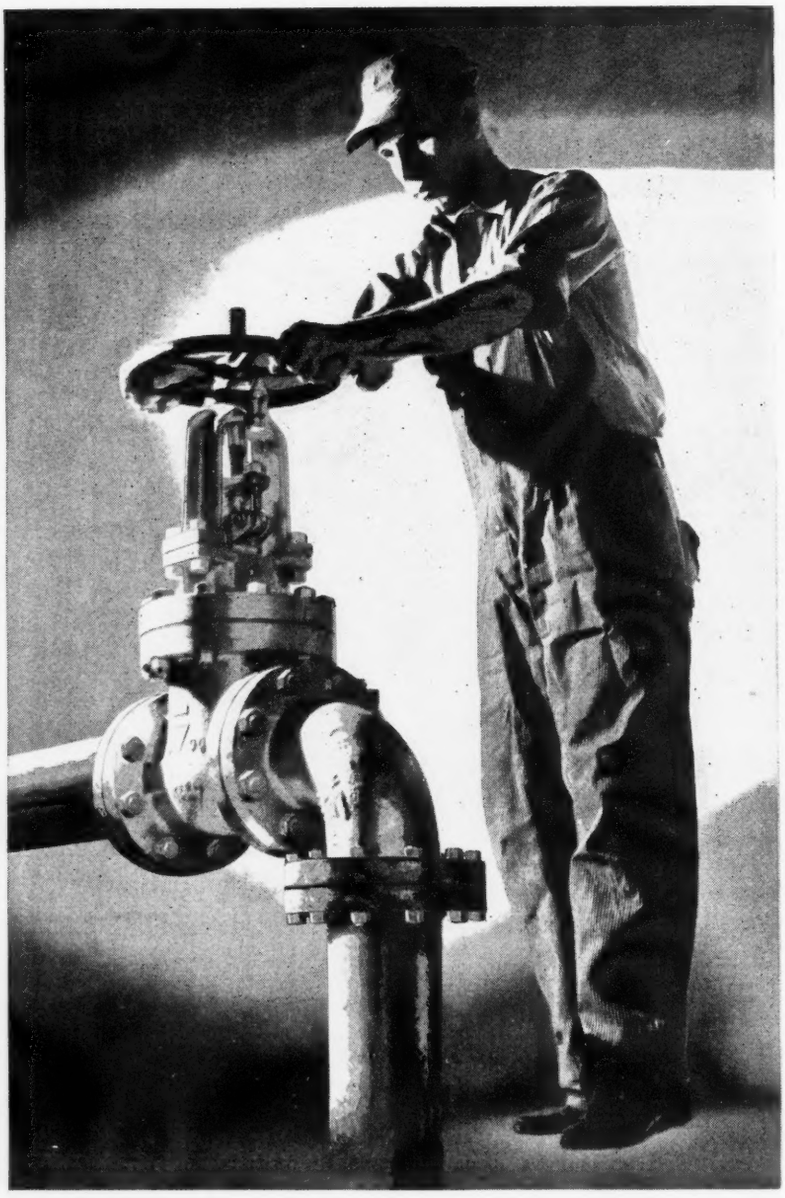
Total Cost for Change: $591.35—including $345.00 for a 50 HP, 1800 RPM motor; $194.35 for two Wedgbelt Pulleys, seven Wedgbelts, and a Tension-Control Motor Base; and a total installation cost of $52.00, including new electrical connections.

Result: Change made more than three years ago. Customer reports that no difficulty has ever been experienced with the American **Econ-O-Matic V-Belt Drive.** American Wedgbelts have shown exceptional life. Customer estimates savings of considerably over $1,000 by eliminating problems of broken shafts, couplings and gears.

This drive has saved more than five times its own cost . . . and double the cost of the whole installation, including the new motor . . . in only three years!

Pulley COMPANY
PHILADELPHIA, PA.

***Econ-O-Matic Drives** are short-center drives, either flat-belt or V-belt, with American Motor Bases for automatic tension control—and thus *automatic economy.*



VICTORY PRODUCTION

The rugged character of R and P&C CO **VALVES** that you found to be a factor in the battle against high production costs now fights for you on the war front.

We are putting all we've got into the job and believe that a sincere all-out effort is the sure way to bring closer the day of Victory.

So it has become even more important that Reading-Pratt & Cady developed valves that will stand the drive of a 7-day production with minimum maintenance—and designed these valves with renewable features so that they can be continued in service at peak efficiency with the use of only minimum quantities of scarce and essential metals.

Reading Cast Steel Valves & Fittings, Pratt & Cady Brass & Iron Valves, D'Este Valve & Engineering Specialties

READING-PRATT & CADY
READING, PENNSYLVANIA

ACCO

A Division of AMERICAN CHAIN & CABLE COMPANY, INC. Bridgeport, Conn.

DEARBORN ENGINEER FINDS THE "LATCH STRING" OUT...

He knows how to solve boiler water problems

Dearborn Engineer does this for you . . .

(1) *Studies* your water and plant operating conditions.
(2) *Sends* samples of your water to main laboratory for analysis.
(3) *Recommends* proper chemical treatment and chemical control methods.
(4) *Supervises* installation of feeding equipment.
(5) *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
(6) *Calls* regularly to insure maintenance of recommended conditions.

DEARBORN ENGINEER solves boiler water problems in all types of plants. His experience ranges from small, low pressure boilers to large, high pressure plants.

He knows local water characteristics, too, because he has worked and lived in his district a long time.

The big Dearborn laboratory gives him the facilities to develop corrective measures that eliminate costly repairs and prevent boiler shutdowns due to scale, foaming, and corrosion.

That is why he is welcome in the engineer's office. His recommendations point the way to trouble-free boiler operation. If there's a chemical laboratory in your plant, Dearborn Engineer cooperates with it . . . if not, there's more need than ever for his advice and assistance. And, he's a friend of purchasing agents . . . especially these days . . . because he helps to get prompt shipments of water treatment materials.

He's a good man for *YOU* to know. If you will write us, we'll gladly arrange for him to see you.

DEARBORN CHEMICAL COMPANY
Dept D, 310 S. Michigan Ave., Chicago, Illinois

Dearborn

WATER TREATMENT AND ENGINEERING SERVICE

HOW you CAN GET

1 MORE SKILLED MAN-HOURS

2 GREATER MACHINE OUTPUT

To Get More Skilled Man-hours, Let G-E Timers . . .

- ★ **Relieve your skilled operators** of nonproductive "clock-watching" work.
- ★ **Make timing operations accurate,** and independent of operators' experience.
- ★ **Warm up glue pots,** furnaces, and similar equipment before work, so your skilled men can put in a *full* day.
- ★ **Maintain operators' efficiency**—and save power—by turning lights on and off at predetermined times.
- ★ **Control speed** of machines and conveyors to suit skill of operators.

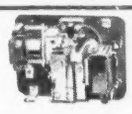
To Get Greater Plant Output, Let G-E Timers . . .

- ★ **Eliminate waste and spoilage** caused by under- or over-timing.
- ★ **Keep motors on line** in spite of momentary power interruptions.
- ★ **Co-ordinate the operation** of separate machines for continuous production.
- ★ **Complete operations** (such as heating and washing processes) after workers leave.
- ★ **Stagger intermittent operations** to keep power demands within feeder capacity and the available supply.

GENERAL ELECTRIC

...with easy-to-apply G-E TIMERS

PICK YOUR TIMERS FROM THIS COMPLETE LINE . . . THEY'RE LOW IN COST

Characteristics	TSA-10 Timer	TSA-14 Timer	CR-7504 Timer	CR2820-1099 Relay	CR2820-1054 Relay	CR2820-1088 Relay
						
General	Telechron-motor-timed interval-type (nonrepeat). Adjustable	Telechron-motor-timed repeating ON and OFF. Fixed time cycle	Capacitor-discharge-timed interval-type (nonrepeat). Adjustable	Telechron-motor-timed interval-type (nonrepeat). Adjustable	Magnetic-flux-decay interval-type. Instantaneous pickup — time-delay drop-out	Magnetic-flux-decay interval-type. Instantaneous pickup — time-delay drop-out
Power supply	25-, 50-, or 60-cycle a-c	25-, 50-, or 60-cycle a-c	25- or 50/60-cycle a-c*	25-, 50-, or 60-cycle a-c*	D-c (also a-c with rectifier)	D-c (also a-c with rectifier)
Maximum voltage	230	230	230	600	600	600
Contact rating 115 v	1 amp	10 amp	1 amp	15 amp	5 amp d-c continuous	5 amp d-c continuous
Contact rating 230 v	1 amp	10 amp	0.5 amp	15 amp		
Circuit arrangement	SP-ST	SP-DT	SP-DT	SP-DT	Up to 4 circuits	Up to 4 circuits
Adjustment range on each form (% maximum time)	0–100% Stepless	1–99% Stepless	5–100% Stepless	Approx 10–100% Steps, approx 5% max. time	Approx 50–100% Stepless	Approx 50–100% Stepless
Range: Forms provide timing From—	0–5 seconds	10 seconds (total cycle)	0.045 second	4 seconds	0.25 second	2 seconds
To—	0–6 hours	1 hour (total cycle)	120 seconds	2 hours	2 seconds	7 seconds
Repeating operation (Close contact, reset, and start new interval automatically)	With one timer (requires additional contact at zero—optional)	Repeats ON and OFF time continuously	Requires two timers—time independently adjustable	Requires two timers—time independently adjustable	Requires two timers—time independently adjustable	Requires two timers—time independently adjustable
Method of setting timing	Optional—either external or internal setting can be locked	Internal	External	Internal	Spring-tension adjustment	Spring-tension adjustment
Ask for these bulletins	GEA-1771	GEA-2963	GEA-2902	GES-2616	GES-2616	GES-2616

* Can also be furnished for operation on direct current.

T-44 General-purpose Time Switch

Telechron motor timed. Opens and closes electric circuits at predetermined times on a daily repeating schedule. Also furnished with astronomic dial for turning circuits on and off at dusk and dawn and with an omitting device to skip the ON operation for selected days of the week. The minimum time interval between successive operations is 45 minutes. 115 or 230 volts; 25, 50, or 60 cycles; SP-ST, SP-DT, DP-ST or DP-DT; 35 amperes. Bulletin GEA-1427

IS YOURS A SPECIAL PROBLEM?

Whenever you would like assistance with a special timing problem, the nearest G-E office will be glad to help.

FOR FURTHER INFORMATION

General Electric, Sec. E676-53
Schenectady, N. Y.

I'd like more information about your timers. Please send me the bulletins checked:

☐ *GEA-1771* ☐ *GEA-2902* ☐ *GEA-1427*
☐ *GEA-2963* ☐ *GES-2616*

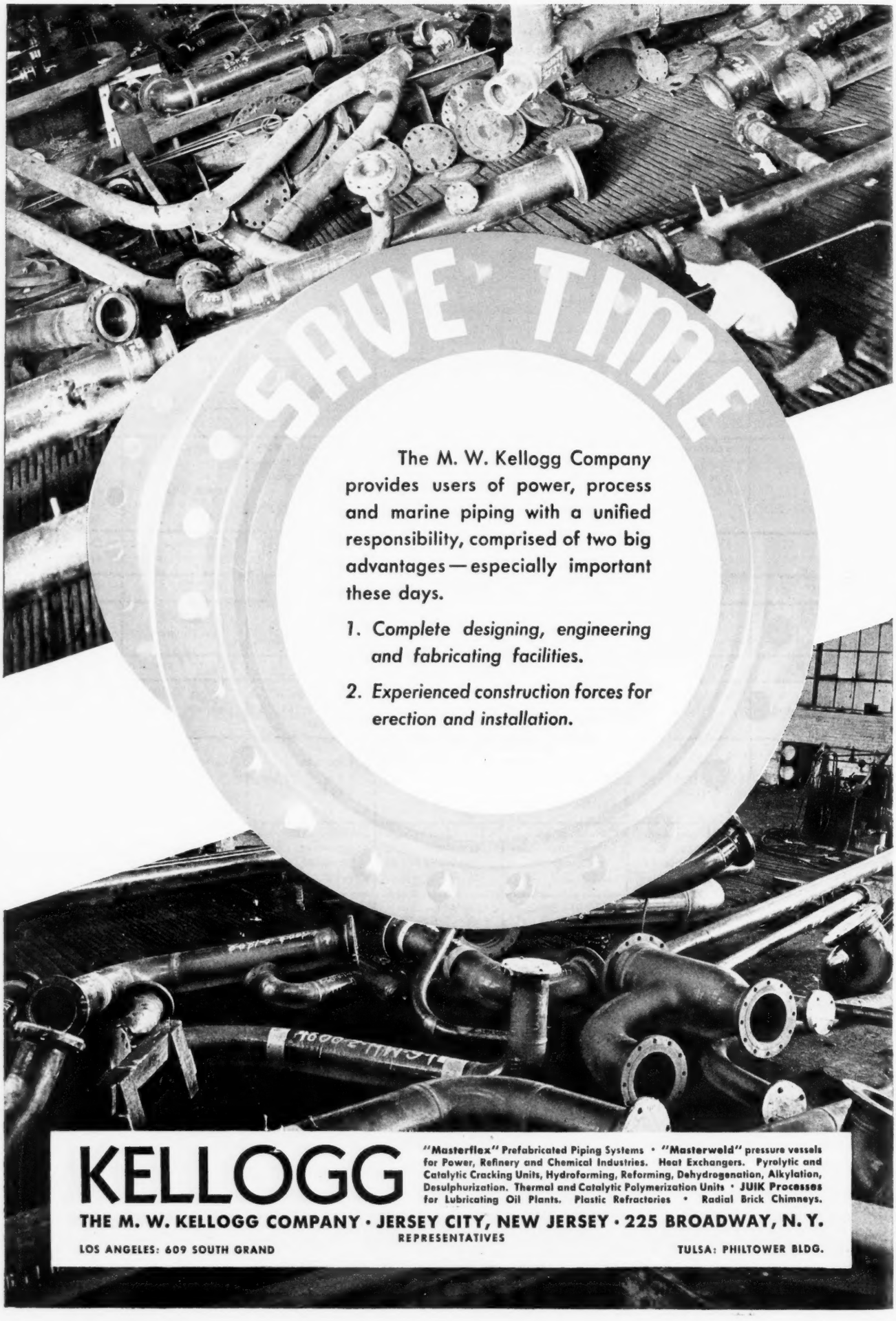
NAME.....

COMPANY.....

ADDRESS.....

CITY..... *STATE*.....

676-53-6500-8490



The M. W. Kellogg Company provides users of power, process and marine piping with a unified responsibility, comprised of two big advantages — especially important these days.

1. *Complete designing, engineering and fabricating facilities.*
2. *Experienced construction forces for erection and installation.*

KELLOGG

"Masterflex" Prefabricated Piping Systems • **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND

TULSA: PHILTOWER BLDG.

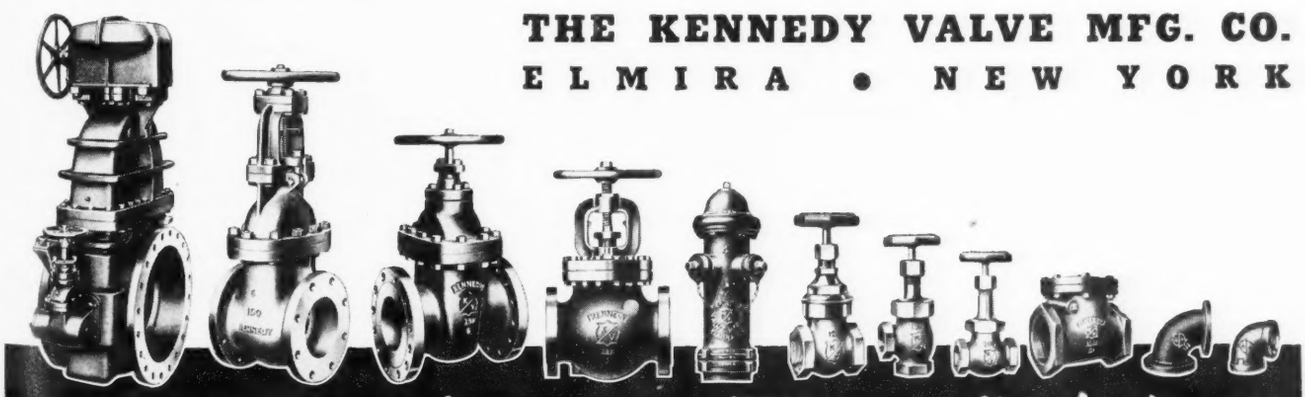
"See...here's why the chief insisted on Kennedy's"

"I was curious to know why the old man was so insistent on having Kennedy Valves installed in our new defense plant . . . so I looked one over carefully. Why, Joe, they not only look good; they have quality in all the corners.

"For example, look how that practical disc holder locks itself on the stem . . . and yet, half a turn, and it drops off. It has four guide prongs, too. And all over the valve I found other little refinements, like the rounded bearing surface, the long threading on the stem, the extra-high raised seat, and the cadmium plated bonnet ring and packing nut. And get the heft of the whole valve. Did you ever see anything sturdier for 150 lbs.?"

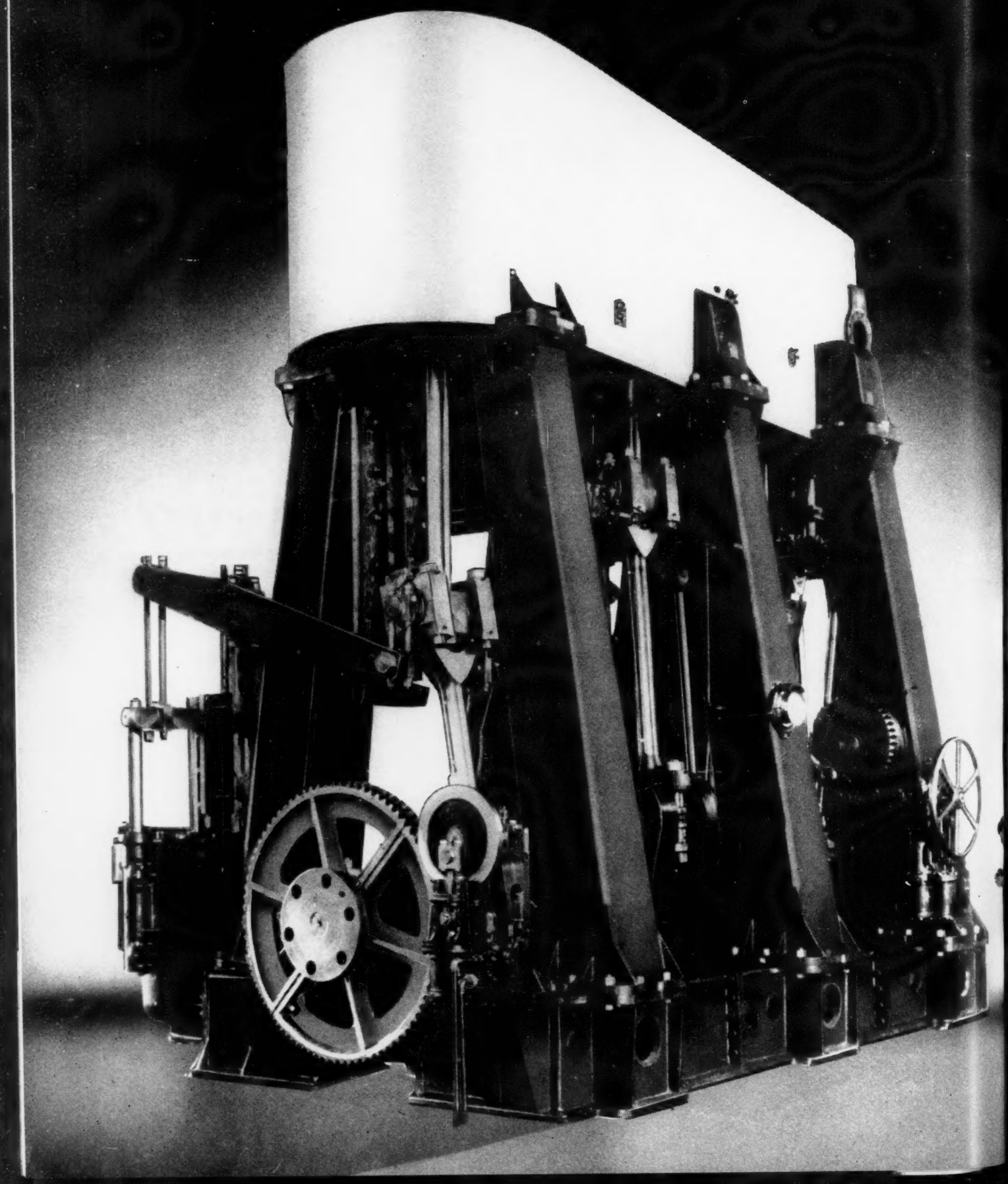
Plant managers and engineers alike have learned that Kennedy Valves and Pipe Fittings on war projects help to assure dependable, uninterrupted, trouble-free production.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK



KENNEDY *valves...pipe fittings...fire hydrants*

CLARK answers t



's the

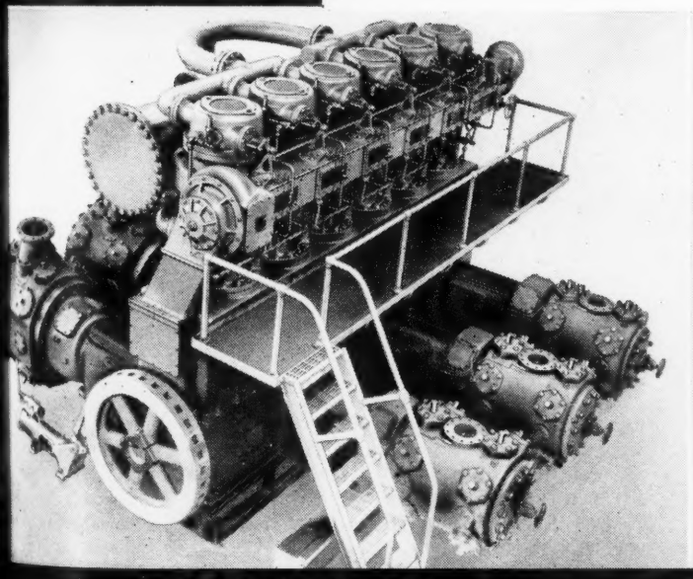
Call to Arms!

AT A TIME when many believe that Democratic ideals are engaged in a fight to the death with the powers that oppose them — CLARK has felt it a tremendous privilege to be able to place its technical knowledge, training and facilities at the disposal of the Government of the United States.

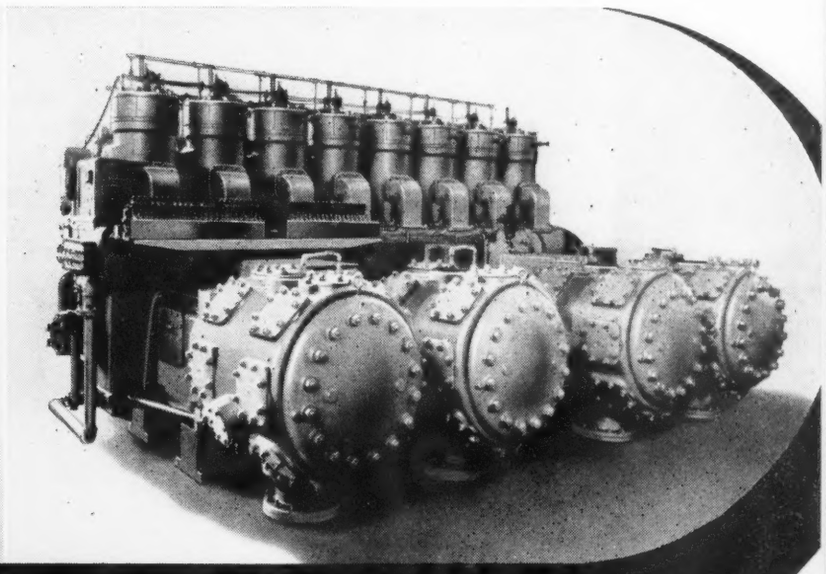
CLARK'S major defense assignment to date has been the manufacture of the Triple-Expansion Marine Steam Engine shown at left. This is similar to the units that CLARK built during the previous war. You can judge from the photograph on the opposite page the size of this huge machine. These engines are being built in the new 200-foot extension to the Olean plant.

CLARK is also building for the High Octane Gasoline Program their Standard Two-Cycle "Angle" Gas Engine Driven Compressors. To increase production of these compressors, new machine tools have been installed, production lines have been increased and all facilities and resources are being directed toward speeding up this very important program.

In addition to the above, CLARK is building for the Chemical Industry large High Pressure "Angle" Steam Engine Driven Compressors in sizes up to 4000 horsepower for compressing nitrogen and other gases used in the manufacture of explosives.



CLARK 3,000 H. P. Steam Driven "Angle" Compressor, now in service in ammonia synthesis plants



CLARK 800 H. P. Gas Driven "Angle" Compressor, now aiding in manufacture of 100 Octane Aviation Gasoline

Clark Bros. Co., Inc., Olean, N. Y. Export Office: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Tex.; Chicago, Ill. (122 So. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5717 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1, London.

CLARK

Extra metal provides *Extra Value* in WeldELLS

BECAUSE the bursting stresses in an elbow are higher in the crotch* the wall must be somewhat heavier in this region if uniform strength is to be maintained. In WeldELLS this needed reinforcement is provided, thus assuring more nearly uniform stresses throughout the fitting.

This feature, based on soundest engineering considerations, is just one example of the *extra value* you get in WeldELLS — just one of eight good reasons for insisting on WeldELLS. And remember, please, that in spite of their premium quality WeldELLS and other Taylor Forge Welding Fittings cost no more.

TAYLOR FORGE & PIPE WORKS, General Office & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street ● Philadelphia Office: Broad Street Station Bldg.

WeldELLS have *everything!*

No other fittings for pipe welding combine these eight features. In addition to that described here these features are:

1. **Seamless**—greater strength and uniformity.
2. **Tangents**—keep weld away from zone of highest stress—simplify lining up.
3. **Precision quarter-marked ends**—simplify layout and help insure accuracy.
4. **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
5. **Wall thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

*The amount by which stress is greater at the crotch in a fitting having uniform wall thickness depends only on its radius. Mathematical analysis (specifically the Lorenz formula) shows the stress at the crotch to be:

$$S = \frac{pr\ (2R - r)}{2t\ (R - r)}$$

Where S = Bursting stress, lbs. per sq. in.
p = Internal pressure, lbs. per sq. in.
r = ½ inside diameter of fitting (O.D. if Barlow's formula is desired).
t = Wall thickness in inches.
R = Center line radius of fitting, inches.

Numerous tests by the Research Division of Taylor Forge show the formula given above to be somewhat on the conservative side.

"HERE'S HELP IN SPEEDING PRODUCTION"

"Send for this new booklet on Gilmer transmission belting—it's crammed with good dope—full of facts on all kinds of belts—tells you When, Where, Why and How to use each type in order to make the most of your machine capacity."

Gilmer BELTS

Whatever you want to know about transmission belting, you'll find it here, in this new Gilmer catalog, especially prepared for times like these. Here are facts and figures—boiled down for quick reading by busy men.

Gilmer makes transmission belts for every purpose. You'll find this booklet specifically covers:

Belts for grinders, drill presses, lathes, woodworking machinery, printing presses, binding machines, separators, sanders, planers and winders, printers' press tapes and band saw bands.

Separate, more detailed catalogs are also available on Gilmer V-belts, Gilmer belts for the textile industry and Gilmer Kable Kord, flat belting, the unique two-belts-in-one construction for heavy pulling.

L. H. GILMER COMPANY
TACONY, PHILADELPHIA, PA.

L. H. Gilmer Company, Tacony, Philadelphia, Pa.

Send me the free booklets I have marked, to help me in driving machines at full capacity.

☐ Gilmer Special Purpose Belts
☐ Gilmer Kable Kord Belts
☐ Gilmer Belts for the Textile Industry
☐ Gilmer V-belts

Name_____

Company_____

Address_____

For faster installation

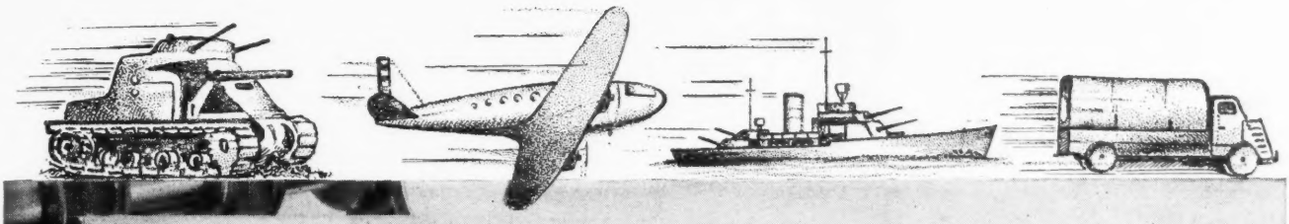
Uniform

BETH-CO-WELD PIPE

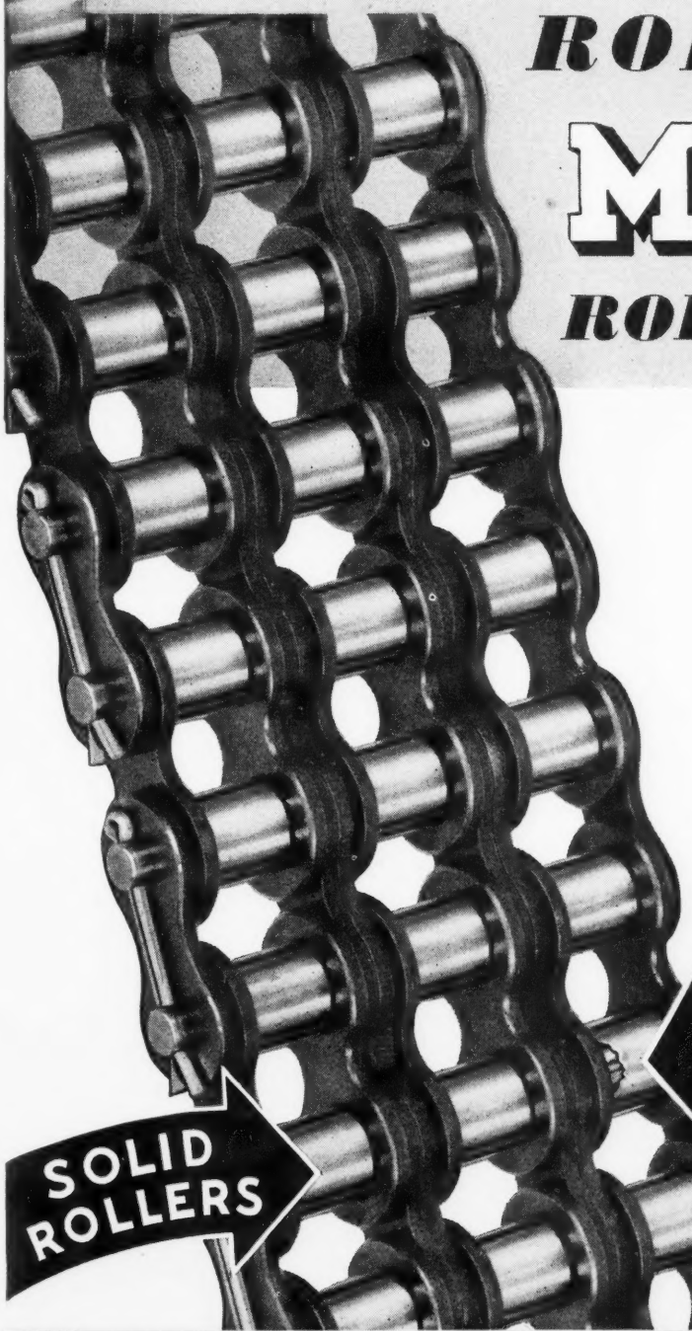
INSTALLATION is faster, easier, when you use Beth-Co-Weld Pipe. And—you get added security, at no extra cost. This new Bethlehem Pipe is made by the Continuous-Weld process, insuring uniformity — in quality, characteristics and strength of weld. Beth-Co-Weld is made in all sizes up to 3 inches, and is available in uniform 21-foot lengths, plus or minus one inch, black or galvanized, standard weight or extra strong.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY



KEEP PRODUCTION ROLLING with MORSE ROLLER CHAINS



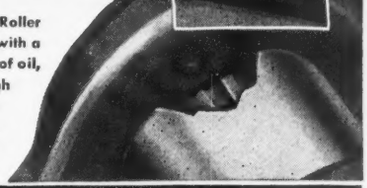
These great power transmitters pass along *all* the power of drivers to production machinery. No slips, no wasted power—Morse Roller "Channel-Lubricated" Chain drives deliver power with constant efficiency. They're rugged, long-lived, reliable. Worries about frequent maintenance or repair shutdowns end with the installation of Morse drives.

On many machines, in many plants, the change to Morse Roller Chain drives has boosted production to new highs, set new records for sustained productivity. First cost is low — maintenance costs are lower, due to the exclusive long-life features not available on less satisfactory drives!

Regardless of your chain requirements there is a Morse Roller to meet them, efficiently, economically. All sizes and capacities, single and multiple widths.

Call the Morse man. He'll help you look for places for profitable use of Morse Roller Chain Drives.

Oil gets in — Wear stays out!

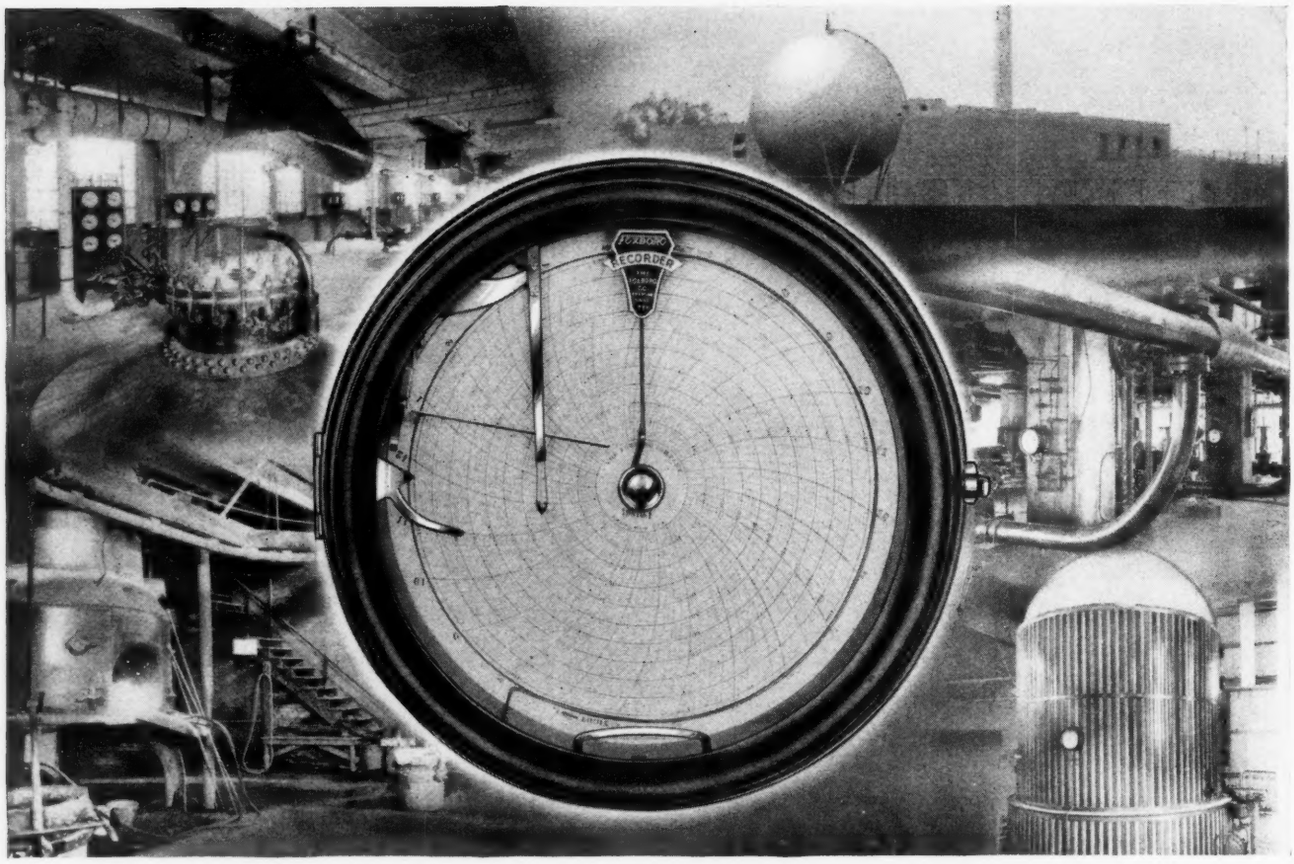


Heart of the Morse Roller Chain is protected with a life-preserving film of oil, flowing there through channels from the bushings. Oil gets in—wear stays out!

SILENT CHAINS · ROLLER CHAINS · FLEXIBLE COUPLINGS · CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.



Name Your Pressures . . .
We Can Fit 'Em!

WIDE RANGE OF SPRING TYPES

Helical Movement, in steel, bronze, beryllium copper or other alloys, for pressures up to 10,000 lbs.

Spiral Movement, in steel, bronze or other alloys, for pressures up to 100 lbs.

Hydron Spring of bronze or alloys, for absolute pressure or special application.

When you install a pressure recorder, why not make sure that it's specifically suited to your installation? For, there is no *single* type of pressure-measuring element that gives *top* results in accuracy and durability for every job.

All you need to do is name your pressure range and service conditions . . . Foxboro can supply a pressure recorder with the type of measuring element that exactly fits! For oil, steam, water, gas, brine or other fluids . . . for pressures from full vacuum to 10,000 pounds . . . Foxboro Pressure Recorders are designed to insure sustained accuracy without maintenance!

This specialized design of Foxboro Pressure Recorders is just one example of Foxboro Creative Instrumentation . . . engineering that gets results for industries through original development and application of recording, controlling and indicating instruments. Write for new complete Catalog 22A of Foxboro Pressure Recorders. **The Foxboro Company, 68 Neponset Avenue, Foxboro, Massachusetts, U. S. A.** Branches in principal cities of U. S. and Canada.

PRESSURE RECORDERS

by FOXBORO

Reg. U. S. Pat. Off.

ATLANTA, GA., Room 713, 101 Marietta Street Building.

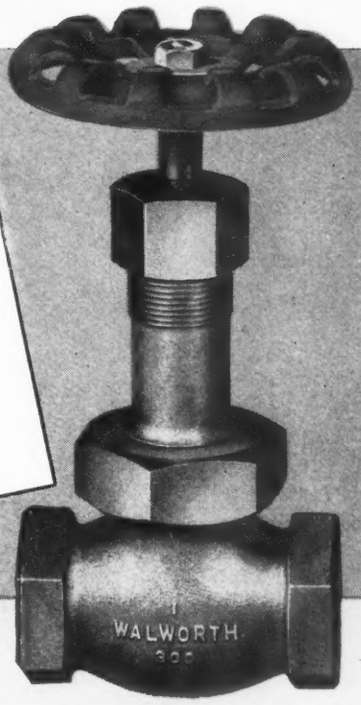
15 MINUTES RE-GRINDING...NOW!

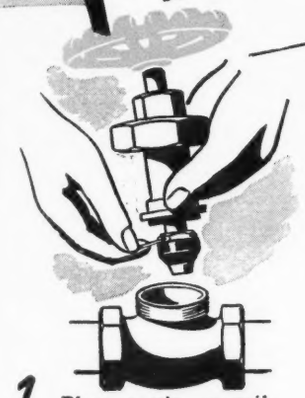
MAY DOUBLE THE USEFUL LIFE OF THAT VALVE

Today, more than ever before, it is important to get the longest possible life from every valve. Walworth is publishing this simplified method of re-grinding in the hope that it will enable customers to prolong the useful life of their valves. It is important that your valves be re-ground as soon as a leak, however small, is discovered.

Continued use without attention may result in a cut so deep that it cannot be removed by grinding. Walworth Re-grinding Valves are designed to be re-ground without removing the body from the pipeline.

Before taking the valve apart, empty the pipeline. This may be done by closing the next valve on the upstream side. Unscrew the union bonnet ring and lift the bonnet assembly.





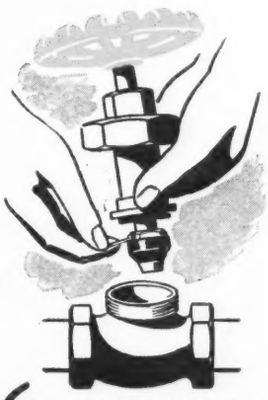
1 Place a pin or nail through the hole in the lower portion of the stem. This hole will be discovered by revolving the disc until the slot in the disc locknut is directly over the hole. With this pin in place the disc and stem are locked together.

2 Apply grinding compound to disc and seat with finger. It is recommended that a grinding compound with an emery base be used.

3 Place bonnet assembly in the body. Hold the bonnet and revolve the hand wheel until the disc touches the seat and until the bonnet is raised about 1/32 inch from the body.

4 Screw on union bonnet ring to hand tightness and then back off about one turn. Oscillate the hand wheel with one hand, meanwhile holding the union bonnet ring firmly to keep it from turning.

5 After pitted surfaces are ground smooth, wipe seat and disc with a cloth that has been dipped in gasoline—be sure all grinding compound is removed from the parts.



6 IMPORTANT! Remove pin from hole in shaft before reassembling valve.

WALWORTH 1842 1942 VALVES AND FITTINGS 100TH ANNIVERSARY

THIS IS OUR CENTENNIAL YEAR

This year marks the 100th Anniversary of the founding of our company, and we had a nice series of "institutional" ads in mind to tell you about it. We hope you saw the first one, which appeared in the January trade publications. Needless to say, that ad was prepared before December 7, 1941, and things have happened since then.

Advertising is conceded to be the most economical means of telling a message to the greatest number of people, and in this period of Priority Production we feel that it is the duty of Walworth advertising to cooperate in a national program of Salvage, Simplification, Specification, and Substitution.

So we've scrapped the "institutional" ads we had planned for our centennial year, and present a series of ads which we think will help valve and fitting users get more service from their existing Walworth material and thereby permit the output of our five plants to be used to the best advantage for Victory in the great national effort.

WALWORTH

VALVES FITTINGS and TOOLS
Backed by 100 Years' Service

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

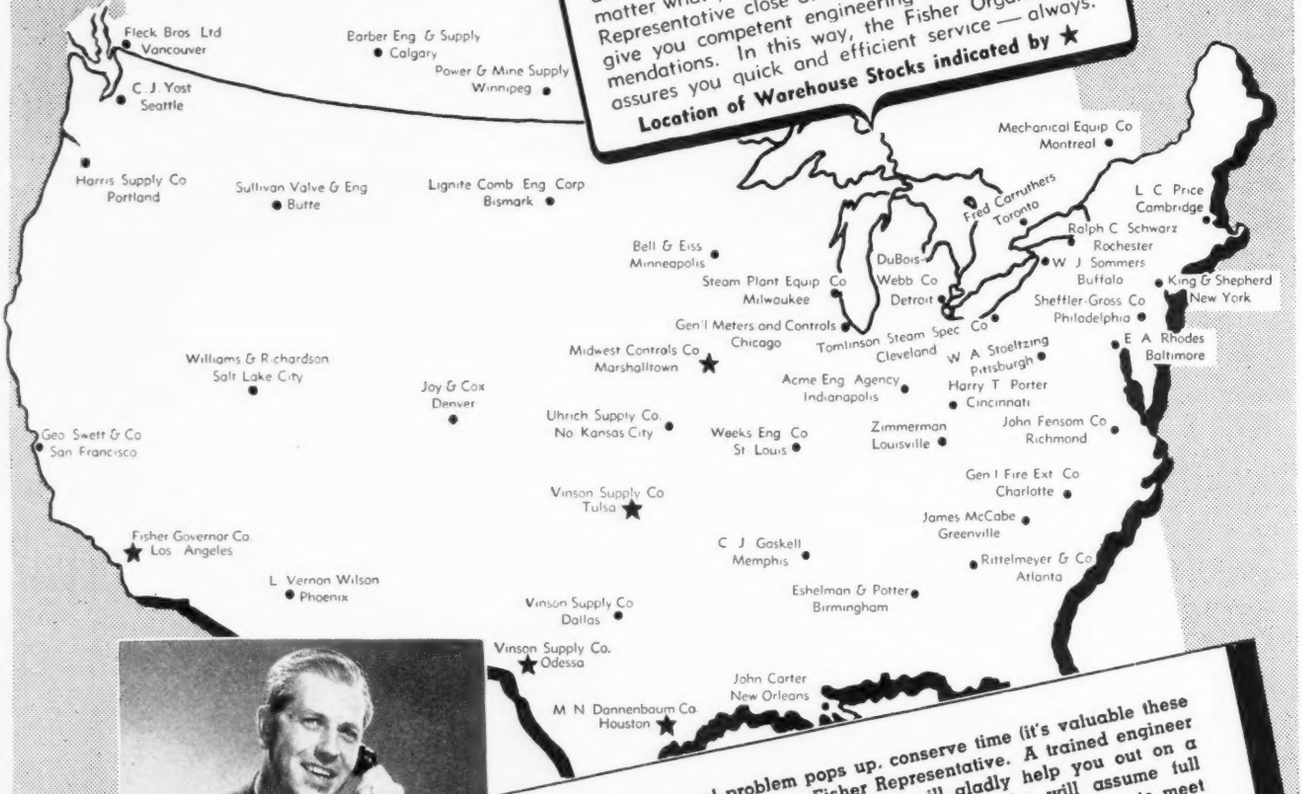
On the alert-

49 Fisher Governor Company Representatives with over 400 Service Engineers are constantly ready to serve you — promptly and efficiently — on all your control problems. Whether your problem is one with existing equipment — or an entirely new control problem — you'll find these Fisher Engineers ON THE ALERT to help you with experienced, expert advice and counsel.

NATIONWIDE SERVICE

Fisher Representatives are strategically located in all parts of the United States and Canada. No matter what your control needs are, there's a Fisher Representative close at hand, ready at all times to give you competent engineering help and recommendations. In this way, the Fisher Organization assures you quick and efficient service — always.

Location of Warehouse Stocks indicated by ★



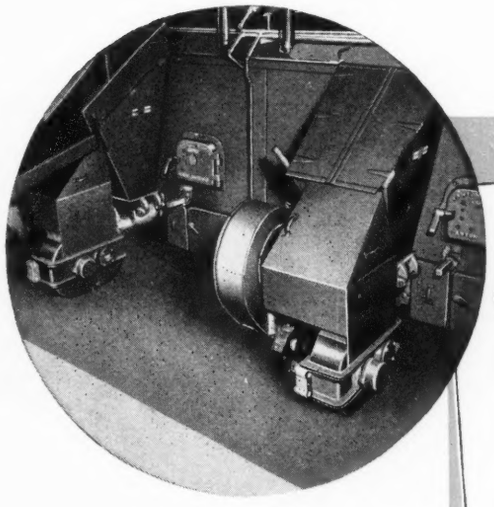
When that control problem pops up, conserve time (it's valuable these days) call your nearest Fisher Representative. A trained engineer will answer your call promptly. He will gladly help you out on a trouble job or if it's a new control problem he will assume full responsibility for determining the correct automatic controllers to meet your exact operating conditions. Fisher Governor Company will then supply the controllers according to his specifications and will guarantee you complete satisfaction.

FISHER GOVERNOR COMPANY

418 Fisher Building
MARSHALLTOWN, IOWA

Pump Governors • Pressure Regulators • Pilot Operated Regulators
Back Pressure Valves • Relief Valves • Lever Valves • Float Valves
Liquid Level Controllers • Strainers • Air and Gas Filters
Steam Traps • Gas Regulators
Automatic Controls of Special Design

CANTON STOKER Engineering saves 174 tons of coal..



Above are shown two of the three Canton Stokers that are on the job saving coal (and money) for famous Grove Park Inn at Asheville, North Carolina.

After a careful survey of Grove Park Inn requirements was made by Canton Stoker Engineers, one Worm-feed and two Ram-feed units were installed. These Canton Stokers replaced firing equipment of another make. Immediately, coal consumption dropped from 492 tons to 318 tons—a 174-ton savings!

Perhaps the same money-saving opportunity exists in your steam plant. Our Engineers are offering timely suggestions to many vital industries, suggesting changes that increase capacity and efficiency and reduce fuel bills.

Your request for helpful literature or personal consultation will receive our prompt attention. Write, wire or phone today.

Below is shown cross-section of a Canton Stoker in operation showing method of feeding and burning coal.

GROVE PARK INN

above ASHEVILLE, N.C.

January 1st, 1940

Mr. N. S. Fulford
District Representative,
Canton Stoker Corporation
Canton, Ohio

Dear Sir:

We submit at your request the following data as to our fuel consumption during the months of October, November and December, following the installation of your stokers as compared with the same months as last year.

	1937		1938	
Oct.	146 tons	Oct.	148 tons	
Nov.	163 "	Nov.	144 "	
Dec.	183 "	Dec.	163 "	

1939	
Oct.	78 tons
Nov.	119 "
Dec.	121 "

The above figures are taken from the daily record and the reduction shown is attributed to various changes which we made in our heating plant. One of the most contributing factors, I believe to be, is the electric driven Canton Stokers installed. We have three of these stokers, one worm type, operating on our vertical 40 H.P. boiler, and two ram type operating respectively 2 H.R.T., 125 H.P. boilers.

The two ram type stokers are equipped with zone wind boxes and inside dump grates which adds much to our efficiency and greatly reduces the smoke and flyash problems.

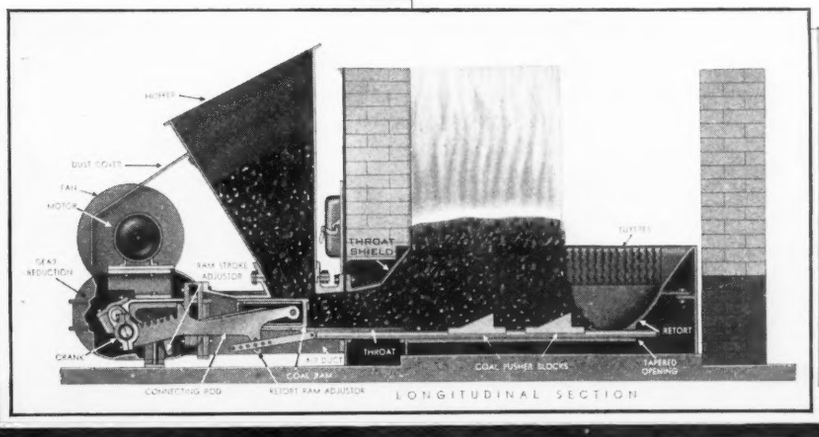
Yours very truly,

GROVE PARK INN

J. P. Roberts

J. P. Roberts
Engineer

JPR
IHB



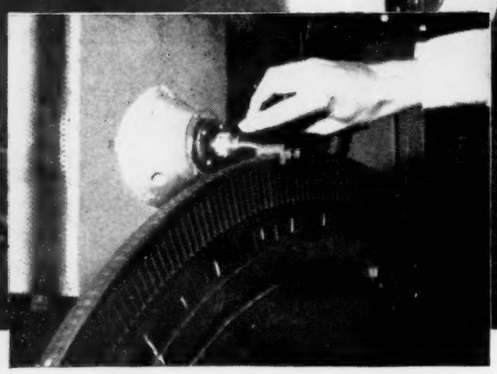
CANTON STOKER

CANTON STOKER CORP. - CANTON O

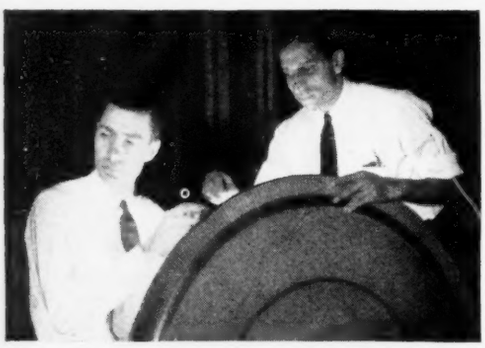
CANTON STOKER CORPORATION

ANDREW PLACE, S. W., CANTON, OHIO

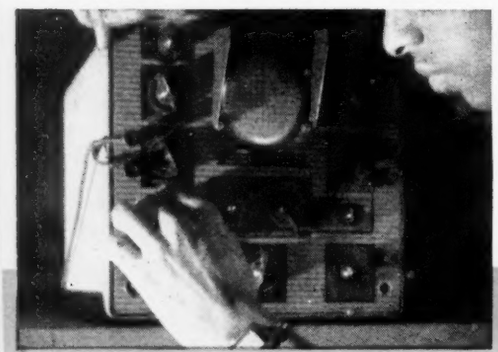
WE TAKE THE PULSE OF TURBINE BUCKETS THIS WAY →→→→→→→



Power supplied by the oscillator vibrates the buckets through a rod connected to a loudspeaker-like device.



Engineers move the crystal detector along the bucket tips and relay the bucket's vibrations to the oscillograph. Points of peak vibration are noted.

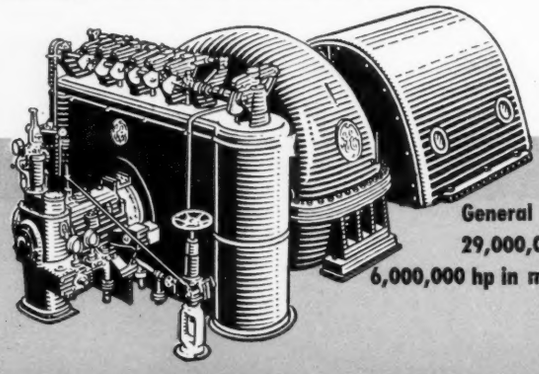


On the screen of the oscillograph the vibrations are magnified 100,000 times to show the frequency at the turbine bucket.

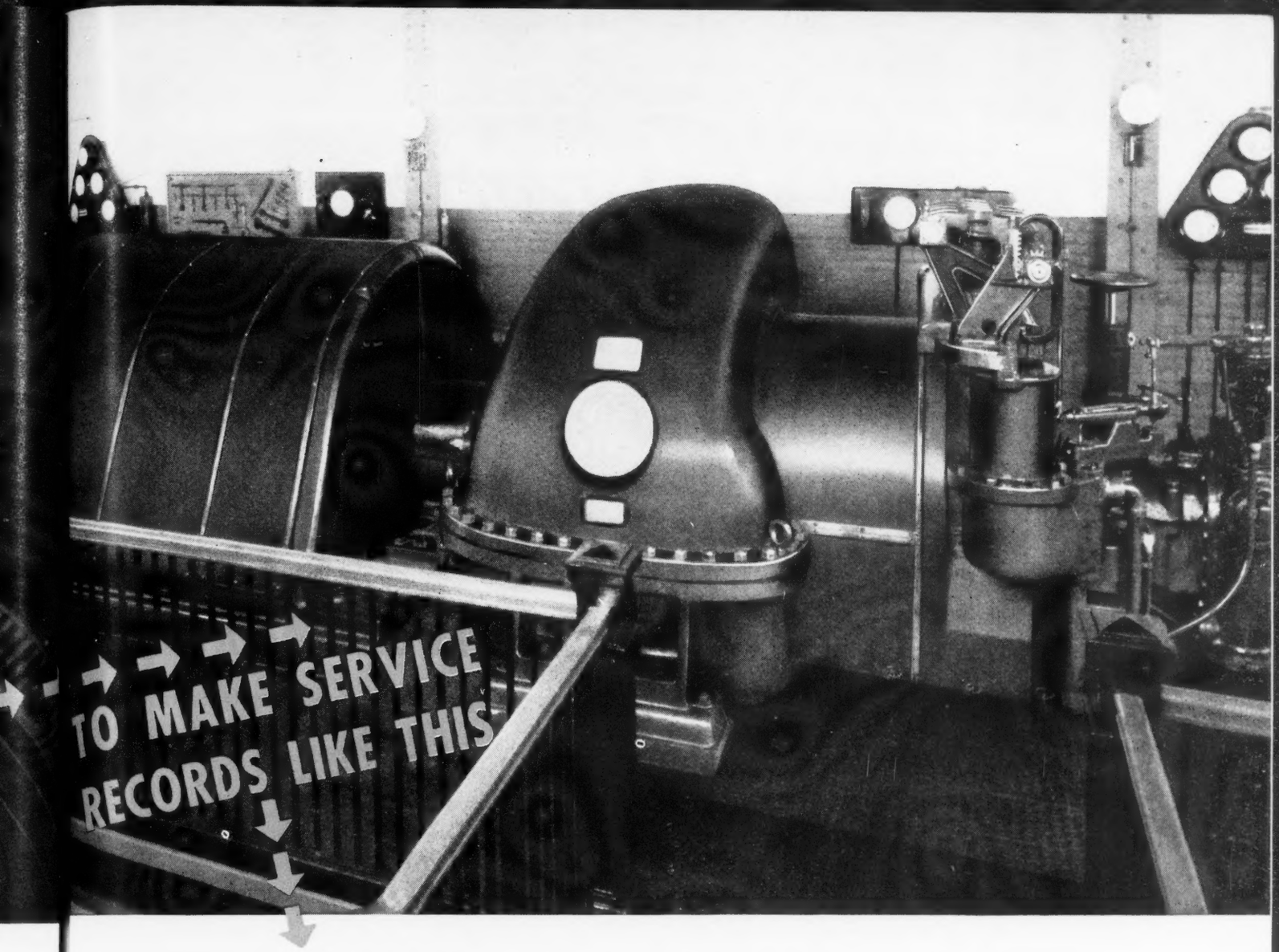
WITH the high temperatures in use today and wheel-tip speeds exceeding 800 miles per hour in many units, it is essential that every feature of bucket design and construction be thoroughly tested. Our turbine designers are constantly studying vibrations in these buckets, but until recently it has been difficult to make comprehensive tests on the shorter ones because of their very high natural vibration frequency—a condition almost impossible to reproduce outside the turbine with sufficient strength for study. The problem of artificially producing and recording such vibrations resulted in developing specialized test equipment—a 1000-watt audio oscillator which produces power at frequencies of 30 to 20,000 cycles per second.

The oscillator (above) produces and delivers power at constant frequency to a loudspeaker-like device which vibrates the turbine buckets. As the buckets vibrate, the engineer moves a crystal vibration detector along their tips to relay their resultant frequency to an oscillograph. By watching the oscillograph screen—where the bucket vibration is magnified 100,000 times—he can study the vibration pattern and then so design a wheel that resonance will not occur at normal speed.

General Electric turbine engineers make use of many other tests. This attention to detail adds to the assurance that the completed turbine will perform up to G-E standards. The results of experienced and skilled manufacture and test are reflected in our large number of repeat orders from leading utilities and industrial plants.



General Electric has built more than 29,000,000 kw in turbine-generators and 6,000,000 hp in mechanical-drive and marine unit.



10 years of continuous service
Less than $450 for renewal parts
200,000,000 kilowatt-hours generated

THAT'S the performance record achieved by one General Electric turbine-generator—in a North Carolina power plant. Every operating hour for ten years, this 5000-kilowatt unit generated dependable, low-cost power without a single mechanical failure. Minor renewal parts—mostly packing materials—cost less than $45 a year. Today, this turbine is helping to carry peak loads as a stand-by unit, while a later 7500-kilowatt, 700-degree, 250- or 450-pound unit, which has been in operation two years, has consistently exceeded the performance guarantee. Coal consumption has been reduced from an average of 1.75 pounds per kilowatt-hour to 1.25 pounds, with a one-day low of 1.14 pounds.

Twenty-six years ago a G-E turbine-generator—a 500-kilowatt unit—was installed in this plant. When additional units were required—five, ten, fourteen, and twenty-four years later—"General Electric" was specified each time. These repeat orders were earned by good engineering.

Whatever the steam conditions, the buyer of a General Electric turbine is assured of superior all-round performance, for in it are combined the results of more than 40 years of constant research and development. The turbine specialist in our nearest office can give you valuable assistance in connection with the use of turbines, not only for power generation but also for mechanical drive. He will be glad to work with you or your consulting engineers in the selection of the right equipment. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

253-4-450

Improve Lubrication to AVOID COSTLY SHUTDOWNS

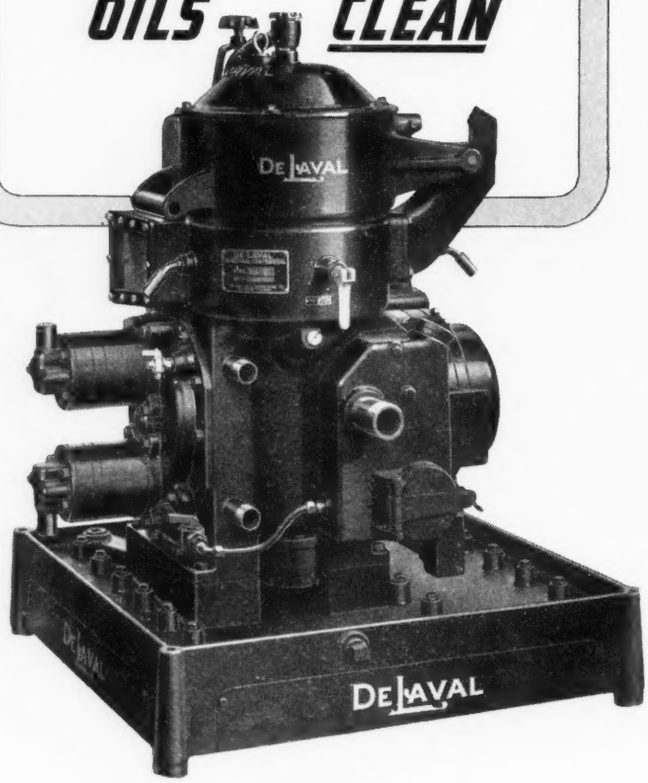
DE LAVAL OIL PURIFIERS *KEEP LUBRICATING OILS CLEAN*

THE De Laval Oil Purifier keeps lubricating oil clean—continuously and unfailingly. Thus, it enables oil to provide a maximum of protection to moving parts. At the same time, it enables the oil to be *safely* used over long periods.

These facts, recognized for many years by builders and operators of prime movers, are now more important than ever.

—And now, too, the superiority of De Laval centrifugal purification is greater than ever before. In recent years efficiencies have been improved so that still cleaner oil is delivered. Capacities have been stepped up so that oil is purified more rapidly. Machines are easier to handle—more nearly fool proof—and require less attention.

Bulletin will be gladly mailed upon request.



THE DE LAVAL SEPARATOR COMPANY
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DE LAVAL PACIFIC COMPANY, 61 Beale St., San Francisco
THE DE LAVAL COMPANY, Limited
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DE LAVAL *OIL PURIFIERS*

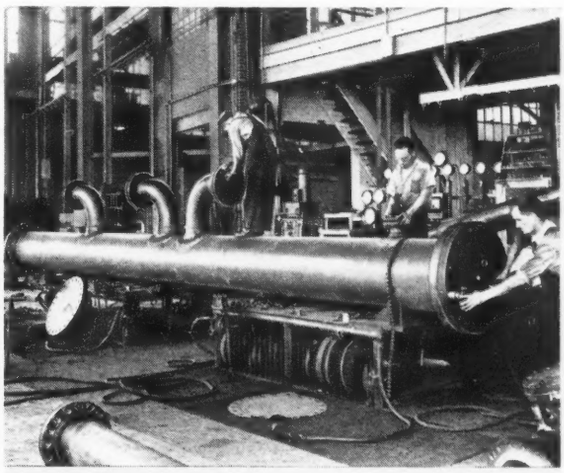
Up-to-Date

PRESSURE PIPING

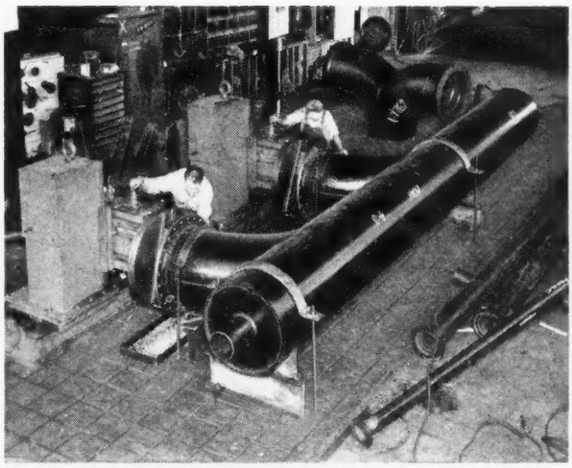
depends upon

Up-to-Date

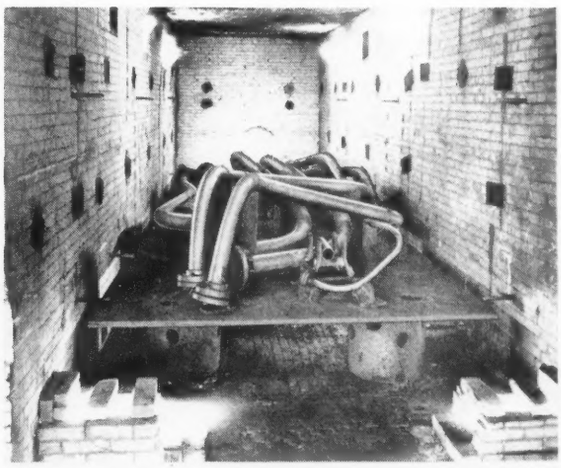
SHOP EQUIPMENT



Adequate testing equipment is another important advantage of the qualified pipe fabricator.



Modern machine tools are used by the qualified fabricator for the accurate facing of pre-fabricated piping.



Furnace for heat treating alloy piping and stress relieving shop-welded sub-assemblies.

Qualified pipe fabricators have the up-to-date facilities for producing better pressure piping. Their plants are equipped with layout tables, form cutting machines, work rotating fixtures, preheating and stress relieving equipment, straightening tables, special testing equipment, etc. These facilities . . . not usually available in the field . . . represent an enormous investment which assures the high quality, speed, economy and easy installation of pre-fabricated pressure piping.

This equipment makes more effective the work of highly skilled organizations . . . including welders who have been trained and qualified on pressure piping. Every operation is under rigid control, supervised by men who have made pressure piping a life study.

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Devoted to the Technical and Economic Problems in Piping

P.F.I. THE PIPE FABRICATION INSTITUTE

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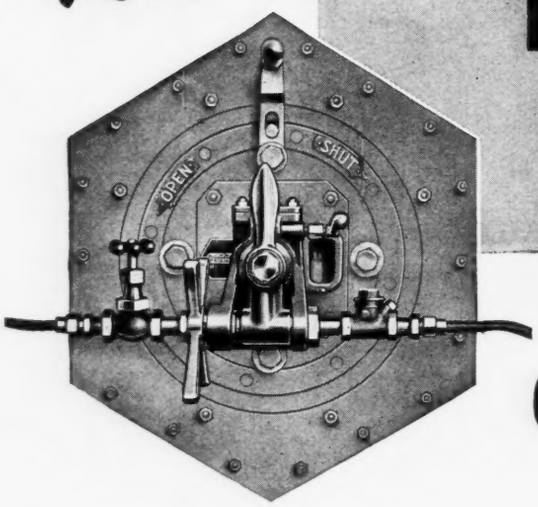

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POWER COUNTS—today as never before! Super-efficient, economical Power. Upping production to unheard-of levels—driving ships at sea—speeding the Victory!

Whatever your share in the War Effort, whatever the size of your plant, a Todd unit, burning liquid or gaseous fuel, can help you get maximum heat and power production, accelerate your whole operation, keep maintenance costs right down to minimum.

Throughout the Nation, in a wide variety of plants producing for the War Effort, Todd products including rotary burners and the famous "VEE-CEE"—with its exclusive "variable range" feature—are today turning in enviable records for achievement. Efficiency, economy, ease of operation and *first-class performance* are always assured—each installation is *individually engineered* to do an outstanding job!

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FOR HIGH TEMPERATURE • HIGH PRESSURE PIPING

MIDWEST GLOBACK JOINTS

Called "Globack" because the back face of the lap is a segment of a globe or sphere, this high pressure pipe joint is a big improvement upon regular lapped (Van Stone) joints. Developed by Midwest, "Globack" Joints have these important advantages: (1) in critical area of lap, the metal thickness is much greater than pipe wall thickness, consequently the lap is stronger in shear; (2) distribution of bolting pressure is uniform, and fair seating of flanges is assured; (3) bending moment to which the lap is subjected is less because the maximum stress is removed from lap periphery and the resultant bolting force is shifted toward the pipe wall.

The Midwest "Globack" principle is also applied to other flanged joint facings: tongue-groove, male-female, etc. Let us tell you about some of the recent outstanding high pressure, high temperature central station piping installations that have Midwest "Globack" Joints.

MIDWEST "GLOBACK" (VAN STONE) LAP

Dotted line indicates full pipe wall thickness (Van Stone) lap, and shows that Midwest "Globack" Joint provides maximum strength in critical lap section—where strength is most needed.

MIDWEST PIPING & SUPPLY CO., Inc., Main Office: 1450 S. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N.J.) and Los Angeles • *Sales Offices:* Chicago—946 Marquette Building • Houston—229 Shell Building
Los Angeles—520 Anderson Street • New York—(Eastern Division) 30 Church Street • San Francisco—426 Call Building • Tulsa—533 Mayo Building

It's cheaper to PREVENT scale than to remove it!

BECAUSE the Graver Hot Process Water Softener combines two distinct principles of water softening—Chemical Reaction and Thermal Action—the removal of scale forming solids is completed with exceptional rapidity. By chemical reaction the injurious elements and compounds are precipitated in such a way that they are quickly removed by sedimentation and filtration. Thermal action hastens this chemical reaction causing quicker settling of precipitate and reducing the solubility of certain chemical salts.

Thus, AFTER-REACTION is prevented and deposition of scale forming compounds in pipe lines, feed water heaters, and boilers is avoided.

Graver Hot Process Water Softeners are the result of more than 30 years of experience in the design and manufacture of water conditioning equipment of all types. Whatever your water conditioning problem may be, it will pay you to consult Graver. Send us a sample of the water you are using. We will make a thorough analysis and submit unbiased recommendations without obligation.

Send for Illustrated Bulletin

OUR bulletin, No. 303, contains complete details, charts and illustrations of Graver Hot Process Water Softeners. We shall be glad to mail you a copy on request. Write today.

Get the facts. Write Graver—Today.

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Rust, oxidation and foaming—one or all three of these bugaboos of modern turbine lubrication can be the cause of costly shutdowns. Protect *your* turbines with Shell Turbo Oil. It is *outstanding* in all *three* ways—

SUPERIOR OXIDATION STABILITY
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RUST PREVENTION

There's no need today to accept less. Call in Shell now!

Keep YOUR turbines humming with

SHELL TURBO OIL

the rust-preventive Turbine Oil

SHELL

The large panel board shown here is a recent installation at Scovill Mfg. Co., Waterbury, Conn., and illustrates some of the varying conditions met by the Cochrane Meter line.

BOILER LEVEL

An electrically-operated differential pressure type Cochrane Liquid Level Meter giving exceptionally high accuracy.

STEAM FLOW + PRESSURE & TEMPERATURE

Electrically-operated, indicating, integrating and recording, friction-free Cochrane Flow Meter, operating on null balance principle, with extra pens for recording pressure and temperature.

HAYS CO_2 METER

Measuring Exit Gas

FEEDWATER FLOW + PRESSURE

Electrically-operated, indicating, integrating and recording, friction-free Cochrane Flow Meter, operating on null balance principle, with extra pen for recording pressure.

BOILER BLOW-DOWN

On continuous blow-down, the solids in the blow-down water often clog standard orifice plates. The Cochrane Linameter construction is unaffected by solids or corrosive waters.

FLOW & TEMPERATURE TO DESUPERHEATER

Electrically-operated, indicating, integrating and recording, friction-free Cochrane Flow Meter, operating on null balance principle, with extra pen for recording temperature.

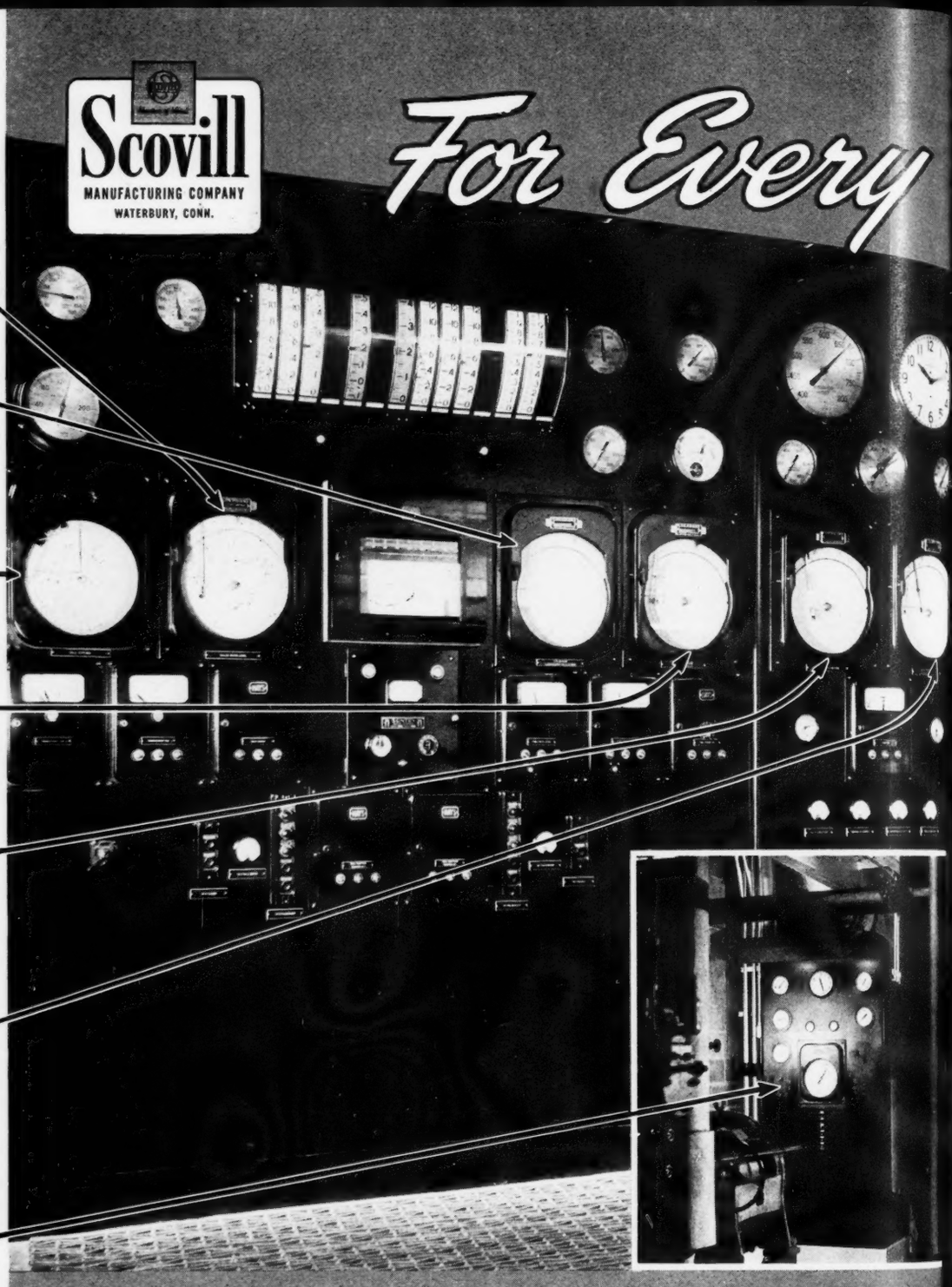
DETACHED INDICATOR

Measuring Feedwater Flow

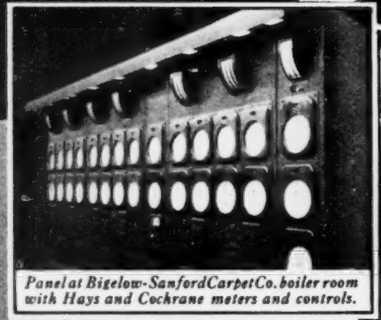
Electrically-operated Cochrane Flow Indicator, uniformly graduated.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

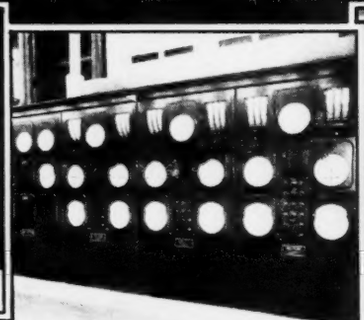
For Every



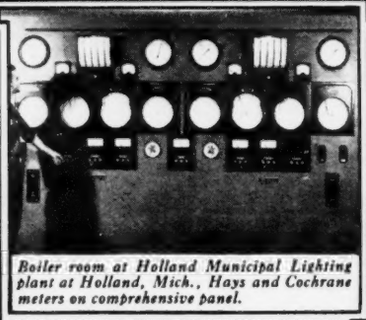
Cochrane



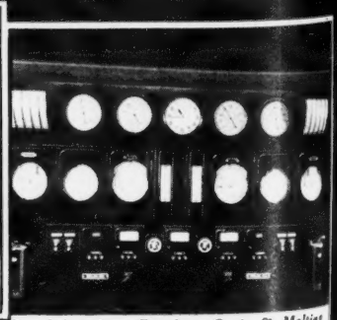
Panel at Bigelow-Sanford Carpet Co. boiler room with Hays and Cochrane meters and controls.



Panel at Iowa State University showing ideal installation of Hays and Cochrane instruments.

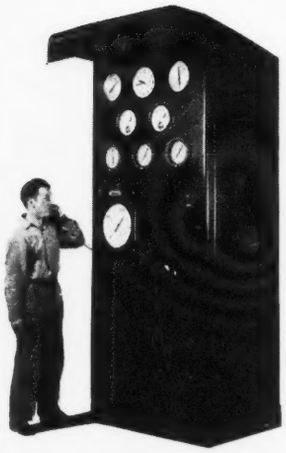


Boiler room at Holland Municipal Lighting plant at Holland, Mich., Hays and Cochrane meters on comprehensive panel.



Panel board at Froedtert Grain & Malting Company with Hays and Cochrane meters and controls.

Flow Requirement



Detached panel board at Scovill plant, showing Cochrane indicator measuring feedwater flow.

COCHRANE Flow Meters comprise a complete line of measuring devices to suit every requirement of fluid flow, together with the measurement of pressure, temperature and level of steam, air, water, gas, sewage, sludge, fatty acids, foamy and viscous liquids.

The line comprises Electric Flow Meters, Mechanical (Tilting U-Tube) Meters, Ring Balance Meters, Linameters, Liquid Level Meters and V-Notch or Weir Meters.

In all Cochrane Meters, high accuracy is attained by eliminating friction as far as possible and by applying ample power to dwarf inherent friction.

Thousands of installations in hundreds of varied industries attest the unfailing accuracy of the Cochrane Flow Meter.

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Most Complete Line of Flow Measuring Instruments

ELECTRIC

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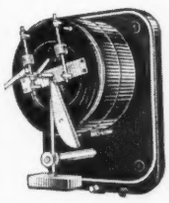

RING BALANCE

LINAMETER

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Flow Meters

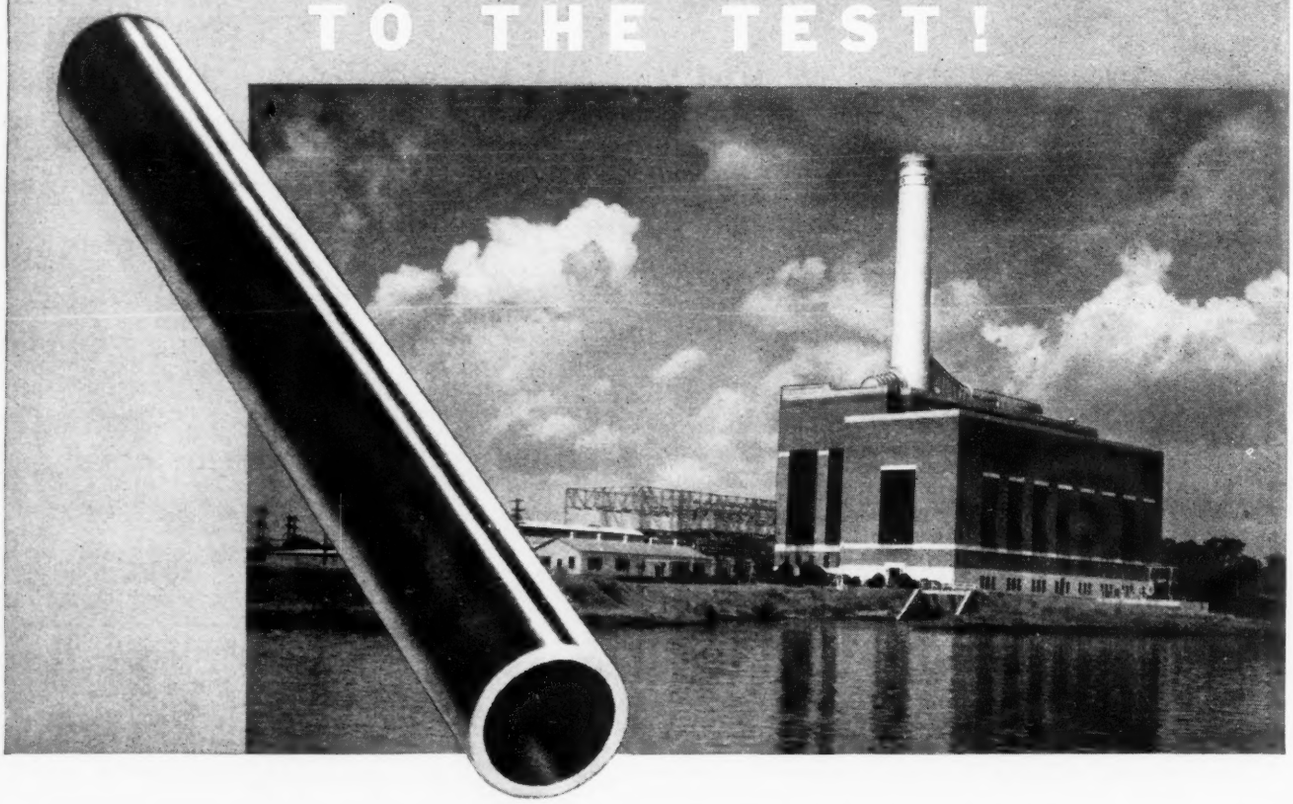
Write for a copy of the big 54-page catalog "Flow Meters by Cochrane."

WHERE CORROSIVE CONDITIONS ARE EXCEPTIONALLY

"TOUGH ON TUBES"...

PUT DURONZE IV

TO THE TEST!



In seaboard power stations where such conditions as circulating brackish water, contaminating sewage, factory waste, silt and cinders raise havoc with practically every kind of condenser tubing, there exists a tremendous problem of tube maintenance that may be overcome by the use of condenser tubes made from DURONZE* IV.

For example, in a particular situation admiralty condenser tubes had failed in less than one year . . . aluminum brass and cupro nickel, although somewhat more durable, likewise were far from satisfactory. Then an experimental lot of DURONZE IV was tried out. It stood up best of all . . . and was remarkably free from thinning and pitting . . . resisting impingement corrosion and providing higher heat transfer value than certain other alloys.

A refractory alloy like DURONZE IV is difficult to produce quickly in times like these. However, it is available to be tried out experimentally for future use. Likewise, Bridgeport metallurgists and engineers are prepared to help you to evaluate accurately the conditions affecting your plant . . . to show how to get the best possible service from present tubing . . . or, if necessary, to recommend the proper tubing alloy as determined by the degree of severity of the corrosive conditions. There is no obligation in taking advantage of this opportunity to make sure the condenser or heat exchanger tubes are . . .

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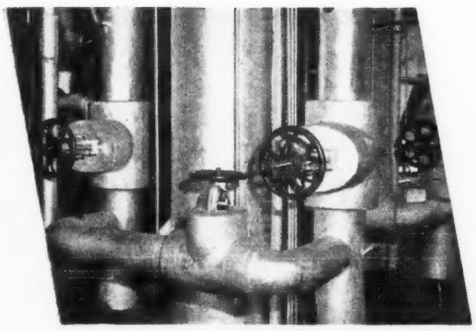
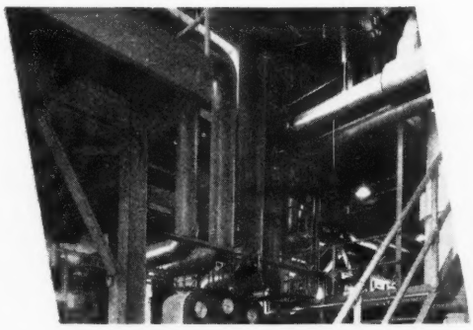
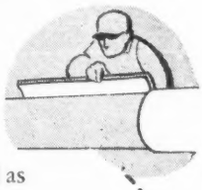


unibestos pipe insulation is providing greater flexibility and ease of application (sectional construction in standard sizes up to 36″); lighter weight and greater structural strength; higher thermal efficiency and the economy of reapplication for production-minded plants throughout the country





unibestos is the economy, as well as efficiency, insulation—Standard and Super material is available in single layer construction. Unibestos can be applied and reapplied over and over again—and it won't shake-down, calcinate or shatter even under the most severe conditions.

unibestos takes paint readily—presents an attractive finished appearance . . . the hard, smooth surface requires no further protection or finish. Unibestos provides a clean-cut insulating job—it saws or cuts easily with ordinary tools and it's easy to strip off layers to fit unions, flanges, etc.

unibestos provides higher insulating efficiency and greater economy. For greater structural strength, higher thermal efficiency, flexibility and ease of application—use Unibestos—the Amosite asbestos insulation!

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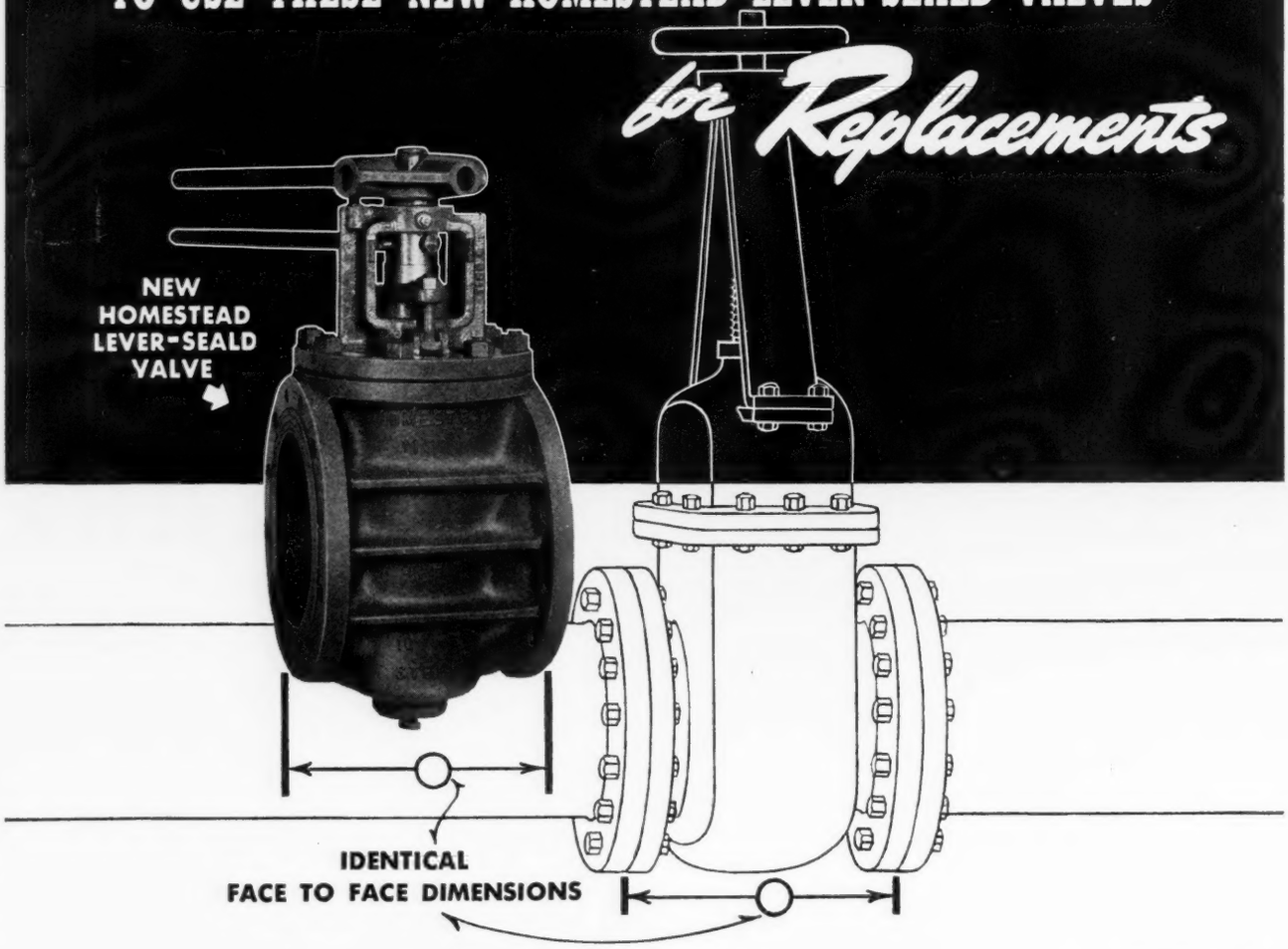
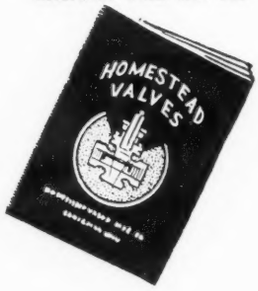
No Piping Changes...

TO USE THESE NEW HOMESTEAD LEVER-SEALD VALVES for Replacements



Now you can have the advantages of Homestead Lever-Sealed Valves on replacements, without the expense and difficulty of piping changes. Face to face dimensions of this new Homestead series are identical with those of corresponding size wedge gate valves. Simply bolt these new Lever-Seald Valves between present flanges, and your valve troubles end! Powerful leverage gives extra ease of opening or closing under the toughest service conditions. Other advantages include quarter-turn operation, protected seating surfaces, straight line flow, and a leakless seal without lubrication. Available for working pressures from 150 to 800 pounds; a choice of metals and alloys for longest service at lowest cost-per-year. Write your needs for specific recommendations by our engineering department.

For engineering facts about these and other Homestead Valves, write for your copy of Valve Reference Book No. 38.



HOMESTEAD VALVE MFG. CO., P. O. Box 210, CORAOPOLIS, PA.

HOMESTEAD VALVES

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STRAIGHT-WAY
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LUBRICATED TYPE
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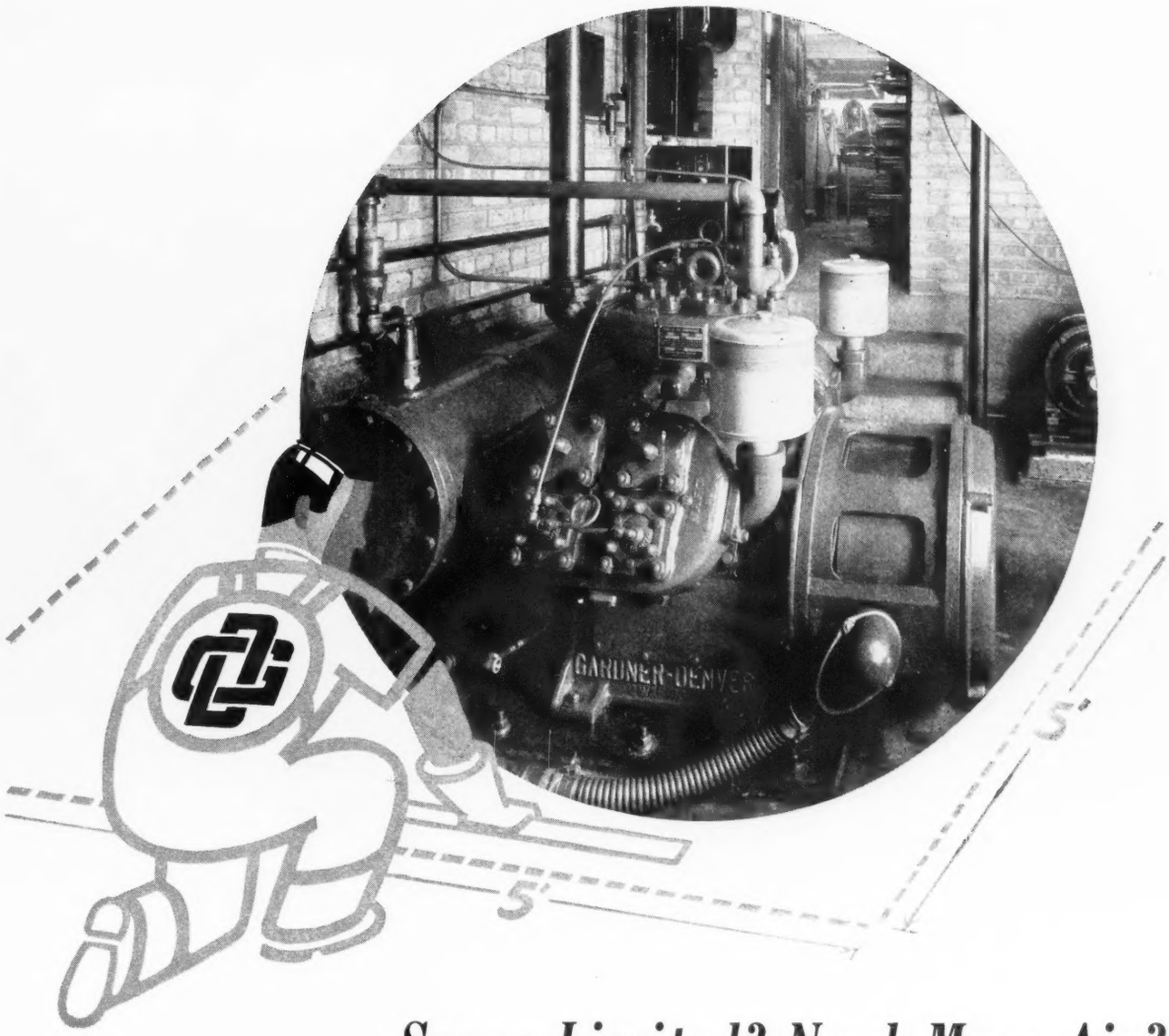
ROSS AIR SHUT-OFF VALVES
HOVALCO BLOW-OFF VALVES



Space Limited? Need More Air?

"Gardy" DuMuch Has The Answer...!

With rush production making space precious in many a plant today, the problem of increasing compressed air capacity is often a very real one. Here is where "Gardy" DuMuch can help you. For "Gardy" represents the ability of Gardner-Denver "WB" Vertical Compressors to provide greater air output in a machine of unusual compactness. With the "WB," you have a plentiful air supply at efficiencies comparable to those of much larger compressors—plus the cost-saving advantages of Gardner-Denver design. Write Gardner-Denver Company, Quincy, Illinois.

"WB" ADVANTAGES:

1 A rugged unit specially designed to conserve space.

2 Fully water-cooled cylinders for lubricating oil economy and cooler discharge temperatures.

3 Castings of GarDurloy give extra strength and hardness where needed.

4 Furnished with direct motor mounting or sheave for "V"-belt drive.

5 Built in capacities from 142 to 445 cu. ft. per minute.

AN EASTERN MANUFACTURING WORKS REPORTS: "The WB compressor unit in our plant has been operating 14 months so far—except for one minor replacement, we haven't put a wrench to the machine."

GARDNER-DENVER PRODUCTS HELP SPEED DEFENSE

GARDNER-DENVER *Since 1859*

Be Prepared for Air Raids WITH Carey BLACKOUT PRODUCTS

THESE SCIENTIFICALLY DEVELOPED PRODUCTS PROVIDE MAXIMUM PROTECTION TO PROPERTY AND PERSONNEL

A blackout, to be fully effective, must guard against two definite conditions—prevent reflection of outside light—provide protection against flying glass. Carey Blackout Products ideally meet both of these requirements.

Civilian Defense Bulletin says: "A factory may be well blacked out, but its glass windows may reflect the light of moon, stars, fires or flares." The practical answer to this problem is to apply Carey Blackout Coating to outside surfaces of all skylights. This coating is non-reflective and insures complete light stoppage with one coat.

Civilian Defense Bulletin says further: "More injuries from flying glass are to be expected than from bombs or bomb fragments." Guard against this danger by applying any one of the three types of Carey Blackout Board to the inside of windows. Boards are rigid; cut to size; easily installed; quickly removable.

Carey Blackout Products are economical and effective because they are specifically designed for blackout use. Proved right by tests. Write today for prices and details. Address Dept. 16.

BLACKOUT COATING—For indoor or outdoor application. Will last indefinitely inside and give upwards of two years satisfactory service outside. Inexpensive; easily applied with large brush, or may be sprayed on; quick drying. Covering capacity 350-400 sq.ft.per gallon. Easily washed off with naphtha, benzol or other solvents.

BLACKOUT BOARDS—Laminated asphaltic boards of good rigidity for removable panel installation. Moisture and condensation proof. Boards are easily cut to shape and size.

ALL-PURPOSE TREATMENT—Where a more permanent, weather proof, or exterior treatment is desired, use the Carey Laminated System. Apply a thick film of

Careyclad Coating and embed 30-lb. Carey Feltex (or Carey Asphalt Saturated fabric membrane) topping with a finish of Careyclad Coating. This provides complete Blackout and renders the glass shatter-proof.

BLACKOUT PAPER—Always keep several rolls of Carey Blackout Paper on hand for quick, temporary repairs. For best results, use a light weight Carey Smooth

Roll Rooting or the less expensive Carey No. 7 FibreWove, a tough asphalt saturated and coated building paper, weighing only 10 lbs. per 100 sq. ft.

REJUVO SYSTEM OF CAMOUFLAGE—During the past year, we have been working with the U. S. Engineers in developing the Rejuvo System for camouflage purposes and a number of trial installations have been made. This special material and equipment for its application are available through the Carey Branch Office organization.

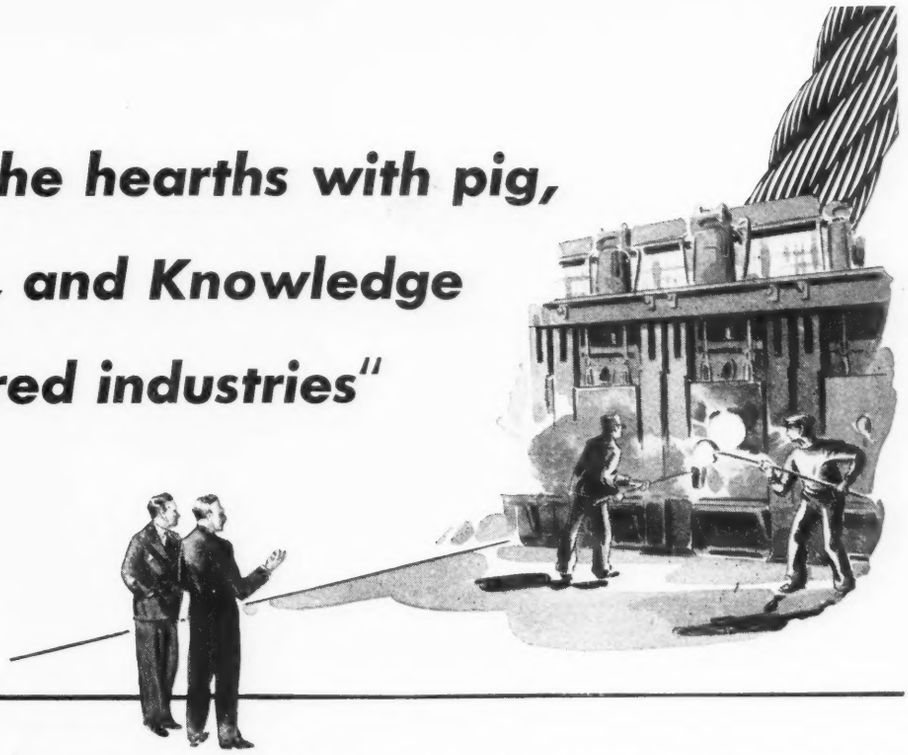
The PHILIP CAREY Manufacturing Company

DEPENDABLE PRODUCTS SINCE 1873

LOCKLAND, CINCINNATI, OHIO

IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory LENNOXVILLE, P. Q.

"You charge the hearths with pig, and scrap, and Knowledge of a hundred industries"

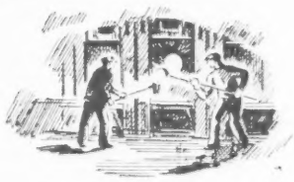


For this is Roebling "Blue Center" Steel

"It's fired for many hours before it's ready to pour, and during the better part of two shifts you put into it many things. Some are ingredients that anyone can use in open hearth steel. And some are not . . .

As the empty hearth begins to glow, you lay your silica bottom. You're making "Blue Center" steel, and it calls for purer raw materials. Good pig, selected scrap and plate.

Long daytime hours and nighttime hours of firing, and at their end, the one right moment when the steel is ready to pour. When is that moment? Shake hands with Andrew Fors, one of those whose eyes since 1906 have been an ingredient of Roebling ingots. Now he's passing his melter's skill on to his son at Roebling. Yes, skilled eyes and eyes alone can tell when the melt is ready. There is no other way . . .



There goes another strange ingredient in. That melter's taken out a sample, to put back something bigger...Knowledge, from the Roebling laboratory and field. Knowledge of a hundred industries, and steel that will exactly meet the needs of each. Every melt's a special melt — right for aircraft control cord, or elevator cable, or factory cranes . . . right for tugboat hawsers, or mine hoists, or oil well drilling lines.

That's the only way you can make the steel we use in "Blue Center" Wire Rope. You start right with the way the ingot's made . . . to meet its job right from the first. We call it "tailored steel", and it's worthy of the Roebling Trade Mark, from the time it leaves the open hearths . . ."

JR ROEBLING

Knowledge of men in the Roebling mills, of Roebling men in the field . . . Roebling process control and engineering and research . . . there's many a hidden ingredient in "Blue Center" Wire Rope. Reasons why it lives so long, and never fails to deliver its full measure of service.

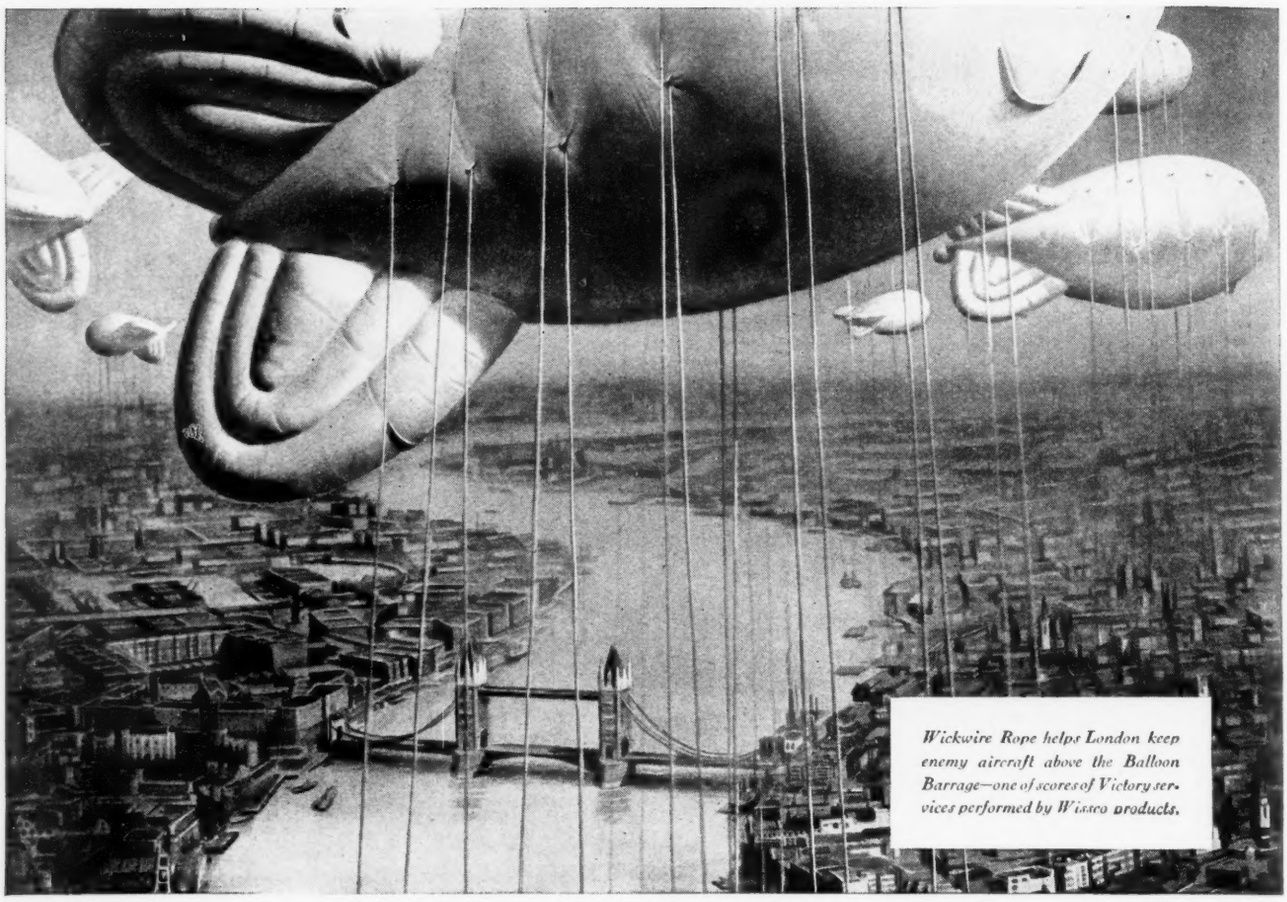
JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches in Principal Cities

THAT'S THE ONLY WAY TO MAKE

ROEBLING

"Blue Center"

STEEL WIRE ROPE
PREFORMED OR NON-PREFORMED



Wickwire Rope helps London keep enemy aircraft above the Balloon Barrage—one of scores of Victory services performed by Wissco products.

A Message About Wire Rope

FROM LONDON'S BALLOON BARRAGE!

Here is a vital message written in steel upon the skies over London . . . where a single order for 587 miles of Wickwire Rope now adds its bit in protecting a great city from dive bombers.

Every foot of that wire rope is an eloquent argument in itself, speaking directly to every user of wire rope—whether used for war, or for essential civilian services.

The message is: VICTORY NEEDS *STEEL!* Victory needs night and day all-out efficiency in every industrial operation. Wire rope that fails too soon wastes steel. The time wasted replacing it is a red stop light on Victory.

You can speed Victory by using wire rope of the correct size and type for your service . . . *then by taking proper care of it, so that it lasts.*

The long life of Wickwire Rope begins with skillful production of the metal in our own blast furnaces. It continues through proud care and precision methods in drawing the wire, and laying the rope. Wickwire representatives give expert help in advising on the best type of rope for each use. And after delivery, Wickwire Service in the field continues to work with you, to assure longest life on the job.

• • •

Our authoritative "KNOW YOUR ROPES" manual, on the selection, application and usage of wire rope, has profited more than 25,000 rope users. Ask for your copy today. Write Wickwire Spencer Steel Company, 500 Fifth Avenue, New York, N. Y.

A FOOT OFF may make your rope last longer. Constant bending and unbending around a sheave will finally wear out any rope. A foot off the rope redistributes the wear. This and forty more rope life-savers are pictured and described in our booklet, "Know Your Ropes."

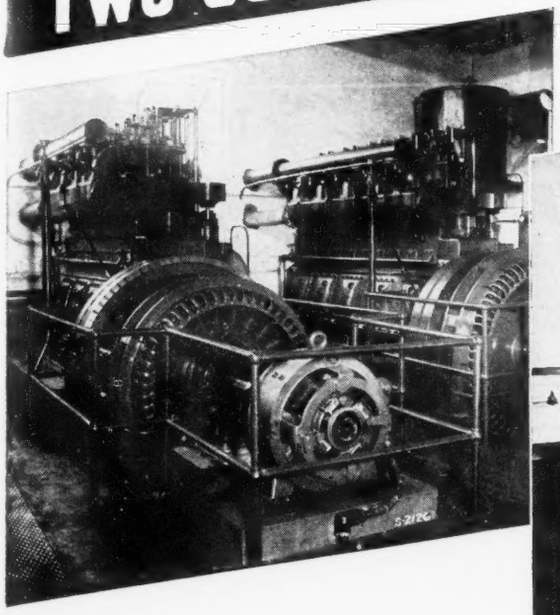
SEND YOUR WIRE ROPE QUESTIONS TO WICKWIRE SPENCER

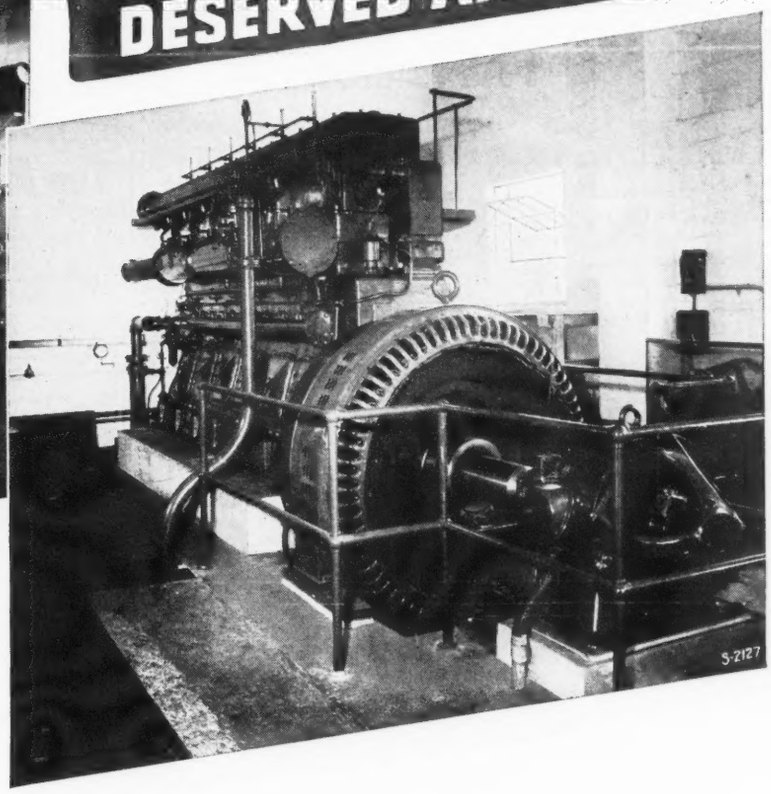
WICKWIRE ROPE

Sales Offices and Warehouses: Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles, Tulsa, Chattanooga, Houston, Abilene, Texas, Seattle. Export Sales Department: New York City

WISSCO PRODUCTS

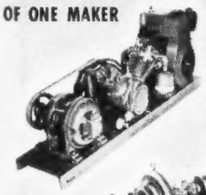
TWO GOOD ENGINES DESERVED ANOTHER



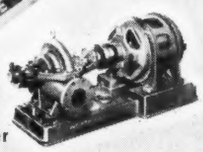


A Worthington 200 kw diesel engine generator unit, a 250 kw unit and a 350 kw unit serving the **BROWN LINSEED CORPORATION** *of Port Richmond, Staten Island, New York. Engine Auxiliaries are also by Worthington.*

WORTHINGTON AUXILIARIES
GIVE ADDITIONAL SERVICE SECURITY THROUGH UNDIVIDED RESPONSIBILITY OF ONE MAKER

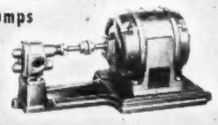


Air compressors for starting



Centrifugal pumps for jacket water circulation

Evaporative coolers for jacket water cooling



Rotary pumps for fuel oil transfer

In 1930, after a thorough investigation of all diesel power equipment available, the Brown Linseed Corporation of Staten Island, New York, selected two Worthington diesel engines . . . a 250-kw unit for daytime operation and a 200-kw unit for night and standby service.

Early in 1934, the Corporation's auditors reported that the engines had paid for themselves, in reduced power costs.

In 1938, increased production demanded daytime operation of both engines. Several months of the year the plant ran 24 hours per day, 7 days per week. During these periods the base load would reach 10 percent above the rating of the units with momentary peaks up to approximately 25 percent overload. So, to meet the need for additional power capacity, this excellent record of reliable performance, plus low operating and overall cost, indicated the logical step . . . the addition of another Worthington unit. The two "veterans" are still very much on the job and, with their third partner, a 350-kw unit, provide all of the power for the Brown Linseed Corporation's important activities in supplying the nation's various defense construction programs.

•

A Worthington engine may offer the solution to your present, or future, power problem. Worthington's staff of qualified engineers will be glad to submit a strictly unbiased recommendation for your individual conditions.

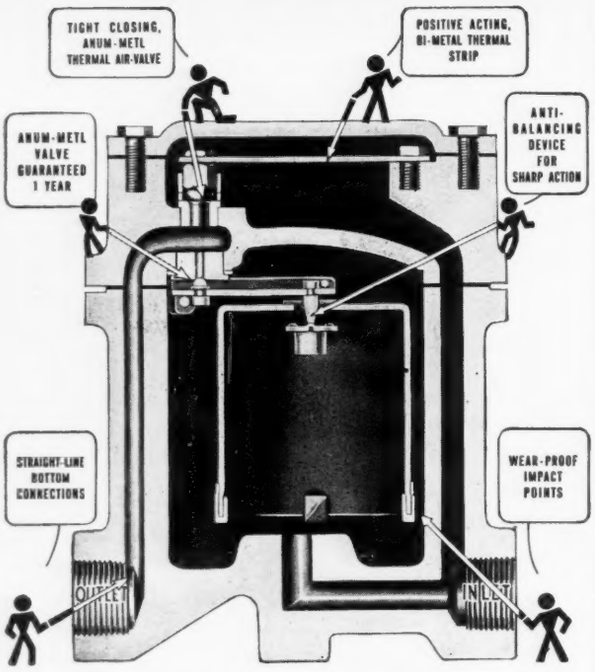
WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

DE2-1

WORTHINGTON

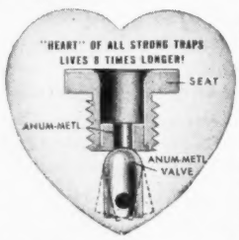
PIPEWRENCH PETE SAYS:

HERE'S THE SURE WAY TO GET HEAT **FAST AND CHEAP!**



STRONG 70-T TRAP

EVERY FEATURE A *Money saver!*



All STRONG traps and valves have seats and discs or special ANUM-METAL that lasts 8 times longer than even STRONG'S former parts. A big money saver

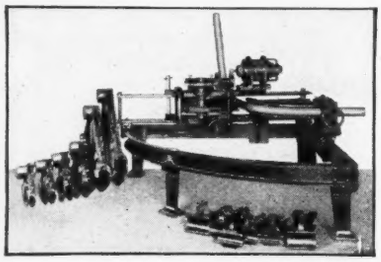
Unit heaters and cookers can be lazy or quick . . . tepid or torrid . . . costly or cheap. They're efficient only when you remove air and water quickly, so steam can fill them.

That makes the trap *important.* Makes the 6 money-saving features of STRONG'S 70-T quick-starting trap vital if you're going to get heat FAST and CHEAP! Same sturdy construction as STRONG'S 80 series trap. A year's guarantee against leakage, too. Worth a 90-day money-back test? Your inquiry will get action quick!

HOW DO YOU SIZE TRAPS? Easy, practical method in Catalog 63-P5. Send for yours today.

The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES



FOR NATIONAL DEFENSE

We Are Ready To Serve You

The American Cold Pipe, Conduit and Tube Bending Machines

New Special Bender for thinnest wall tubing from 1/64 down. Used with the new Cerrobend filling.

Another new bender for extra heavy pipe up to 3".

Quick Deliveries . . .

Hand Operated Types in capacities of 1 in., 2 in., 3 in., and 4 in.

Motor Operated in three capacities, ½ in. to 4 in., ½ in. to 6 in., and ½ in. to 8 in.

IMMEDIATE SHIPMENTS on hand operated machines; on motor powered from two to four weeks.

Wire or air mail letter for printed matter and prices.

AMERICAN PIPE BENDING MACHINE CO., INC.
23 Pearl Street **Boston, Mass., U. S. A.**

PEALE, PEACOCK & KERR

Graybar Bldg. NEW YORK
Broad St. Station Bldg. PHILADELPHIA

AIR CLEANED

BITUMINOUS VICTOR COAL

ALL SIZES

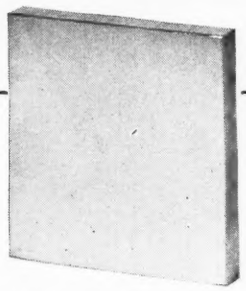
Produced by us in the heart of Central Pennsylvania's field, low and medium volatile, and of uniform and dependable quality.

Our Fuel Service Engineers are at your call. They are qualified to aid you in getting the utmost in satisfaction, efficiency and economy from your equipment and the specific conditions under which it operates.

Standard Quality Anthracite

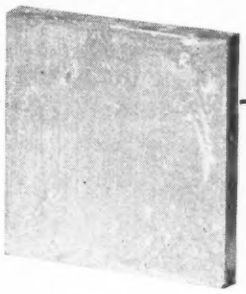
RUST INHIBITIVE INSULATION!

Camera proof that Eagle Super "66" Plastic Insulation actually prevents corrosion



Flat polished steel plate—type used in making extensive laboratory tests to check rust-inhibitive properties of various kinds of plastic insulation.

Rusted, pitted surface of identical steel plate which was coated with ordinary plastic insulation and subjected to room temperatures for several weeks.



Identical steel plate after coated with Eagle Super "66" Plastic Insulation (applied wet) under same conditions. Note absence of rust or corrosion.

DOUBLE Protection Against Corrosion!

Eagle Super "66" does far more than effect sensational conservation of fuel in your plant.

Now this remarkable plastic insulation also checks rusting and corrosion of equipment. In addition to its natural non-corrosive properties, Eagle Super "66" is actually a rust inhibitor.

Of all plastic insulations tested in the laboratory, only Eagle Super "66" showed this desirable quality. All other insulations allowed corrosion of the surface to which they were applied.

Many other advantages: The basic insulating material in Eagle Super "66" is both chemically and physically stable. It does not deteriorate or disintegrate in use.

And its "springy-ball" structure assures positive heat control for temperatures up to 1800° F. . . . smooth-troweling application . . . maximum dry coverage (50-55 sq. ft. 1-in. thick per 100 lbs.).

Write today for new catalog sheets which give technical data on efficiency and application.

2 WAYS TO CONTRIBUTE TO NATIONAL DEFENSE

1. Conserve fuel.
The more efficient the insulation you apply to your equipment—the more fuel you can conserve—the more you can step up your plant efficiency. By applying insulation that does not lose its effectiveness or disintegrate, you can also operate with fewer shutdowns. Install only insulation that has proved its ability.

2. Protect Insulation.
Insulation that is worth installing is worth protecting. Eagle Insulseal is suggested for this job. This durable, fireproof coating protects all kinds of heat insulation from disintegration and loss of insulating value. Safeguards against air infiltration, moisture, water, fumes—against vibration and abrasion.

Eagle-Picher High Temperature Insulations

Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

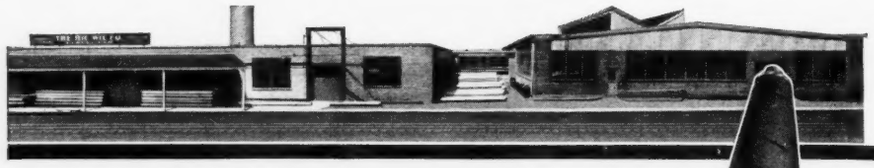
EAGLE EP PICHER

Eagle Finishing Cements
Eagle Loose Wool
Eagle Insulseal
Eagle Insul-stic

THE EAGLE-PICHER LEAD COMPANY · CINCINNATI, OHIO

NOW...

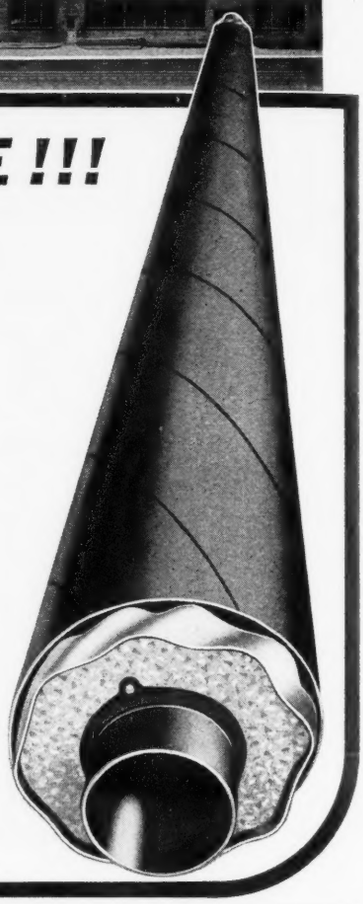
TIME IS THE ESSENCE !!!



USE PRE-FABRICATED INSULATED PIPE UNITS

● Ric-wiL has applied production-line manufacturing methods to turning out correctly designed, factory pre-fabricated underground steam conduit systems ready for installation. These units save most of the field assembly time required by other types of conduit, and they assure minimum and predetermined costs on the job. They eliminate construction bottlenecks, turmoil, and headaches.

Over half a million feet sold for government defense work alone. All parts are standardized and precision-made in the factory, including expansion fittings and all necessary accessories. Units are completely finished in the shop—nothing else to buy! Any type insulation. For ACTION—get in touch with your nearest Ric-wiL representative. Write for latest bulletins.

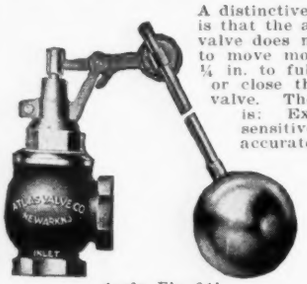


THE RIC-WIL CO. CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

The float merely
"Pushes a Button"

and then SUPPLY PRESSURE does the actual heavy work of positively opening and closing the large valve. This float valve is known as the

Auxiliary Operated ATLAS Float Valve



A distinctive feature is that the auxiliary valve does not have to move more than ¼ in. to fully open or close the main valve. The result is: Extremely sensitive and accurate operation.

Angle, Fig. 214. Globe, Fig. 214a.

This remarkable Float Valve is **guaranteed** to be **positively drop tight.** It can be installed within the tank or in the supply line outside of the tank and operated by a float in the tank. Strong and durable. Sizes ½" to 10". Globe or angle. Screwed or flanged.

We make regulating valves for every service. See list in the coupon. If the list does not contain what you want—inquire.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
289 South St., Newark, N. J.
Representatives in Principal Cities

Atlas Valve Co., 289 South St., Newark, N. J.
Please send information on the following Atlas products without obligating me in any way:—

☐	Float Valves	☐	Pump Governors
☐	Campbell Boiler Feed Water Regulator	☐	Oil Control Cocks
☐	Temperature Regulators	☐	Pressure Regulators
☐	Reducing Valves	☐	Thermostats
☐	Exhaust Control System	☐	Balanced Valves
☐	Damper Regulators	☐	Control Valves
		☐	Humidity Controllers

Name.....
Firm.....
Street.....
City..... State.....

KEEP BOILERS AT TOP EFFICIENCY – TO MEET INCREASED DEMANDS FOR POWER

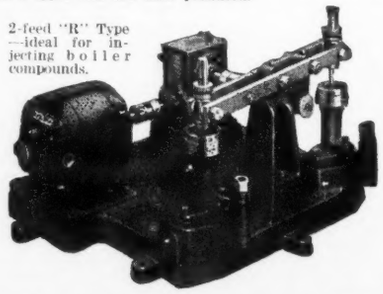
Stepped-up production, accelerated schedules, government contracts . . . today's needs for power demand the utmost from every unit of equipment.

If scale is reducing efficiency of your steam and hot water boilers, or if present methods of water treatment are wasting chemicals, install Hills-McCanna Pumps. They are easy to install, accurately adjustable, and can be synchronized with your water intake lines to keep pace with increasing power needs.

Pump capacities as small as a fraction of a gallon per hour, or as high as 1500 g.p.h. are available in the 9 types and 200 sizes produced.

Typical Applications Include: Proportioning in both internal and external treatments, oxygen removal, slime removal, etc. Compounds handled include mono-, di- or tri-sodium phosphate, pyro-phosphate, organic colloids, caustic, soda ash, sulphates, aluminates and tannins.

2-feed "R" Type—ideal for injecting boiler compounds.



HILLS-McCANNA CO., 2369 Nelson St., Chicago

HILLS-McCANNA Positive PROPORTIONING PUMPS

We've Spilled the WORKS!

All the works—two discs and two wedges—four parts—the entire working part assembly of a Darling Double Disc Gate Valve. The seats are parallel. The discs are *fully revolving,* seating in a different position *each time* the valve is operated. This means tighter seating, less wear, longer operation, and lower maintenance costs with Darling Gate Valves. All four working parts are uniform and positive in action. They are simply designed, with no pockets to collect sediment or prevent free and easy movement. Any part can be replaced quickly and inexpensively without removing the valve from the line. They cannot be incorrectly assembled or become disengaged while in service. It's an assembly that will more than pay its way in your plant.

At your service are the engineers of the Darling Valve & Manufacturing Company. They can solve your valve problems without cost or obligation to you. Wire or write, setting appointment at your convenience.

Darling offers you a quality line of longer-lasting Gate Valves. They come in Fully Revolving Parallel Seat Double Disc, also in Taper Seat—Slotted and Solid Wedge types. In service pressures up to 3000 pounds, you can get Darling Gate Valves in Cast Iron, Bronze, Forged Steel, Cast Steel, and Corrosion Resistant Alloys. Darling also manufactures Compression Type Fire Hydrants, Check Valves, Motor and Cylinder Operated Valves, and many accessories.

TRADE DARLING MARK

VALVE & MANUFACTURING CO.

WILLIAMSPORT, PA.

BUILDERS

RECORDING·INDICATING·CONTROLLING

Instruments

for

METERING FLOW

Liquid Level • Weight

VENTURI

Builders Venturi Meter is equally respected in boiler rooms, water works, and sewage disposal plants everywhere. For the super-accuracy required by central stations, each Type M is adjusted to match exactly its University-calibrated Venturi Tube. Write for Bulletin 324.

CHRONOFLO

Builders Chronoflo Telemeter brings measurements of flow, level, pressure, temperature, and weight from any distance to centrally located indicating and recording instruments. The Chronoflo time impulse Meter has more than fulfilled its promise. Write for Bulletin 320.

FLO-WATCH

An attractive flow meter as accurate as it is good-looking. This recording, indicating, and totalizing meter is designed and priced to allow wide use throughout the plant. Equally serviceable with Venturi Tube, Flow Nozzle or Orifice Plate. Write for Bulletin 318A.

SHUNT

Again and again, hundreds of firms have purchased Builders Shunt Meters to measure steam, air, or gas that they sell to customers or distribute to various departments. Low price and accuracy are but two of the many Type KS advantages. Write for Bulletin 307.

BUILDERS - PROVIDENCE, INC.

(DIVISION OF BUILDERS IRON FOUNDRY)

14 CODDING STREET PROVIDENCE, R. I.

KNOW ELECTRICITY

AS EXPERTS KNOW IT

—and get an expert's pay!

Just one new idea, one new fact, one new wrinkle, gotten from these practical books every day—and do you realize where you would be in six months or a year? Many men have backed up their experience in this way, to get in the big-pay skilled electrician class twice as fast. You can too!

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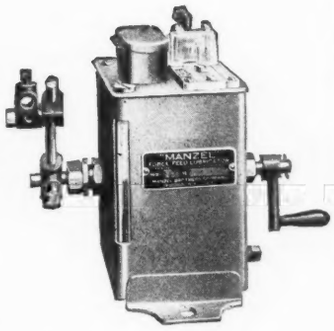

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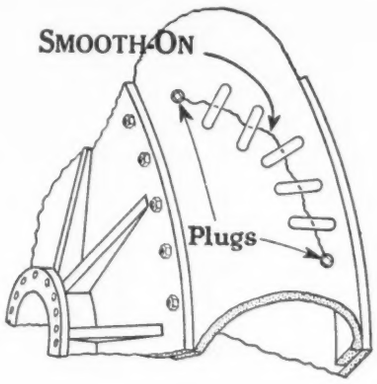

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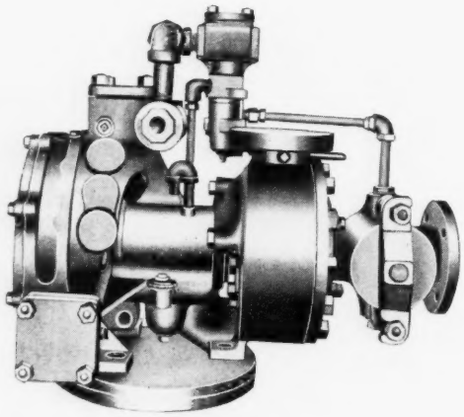

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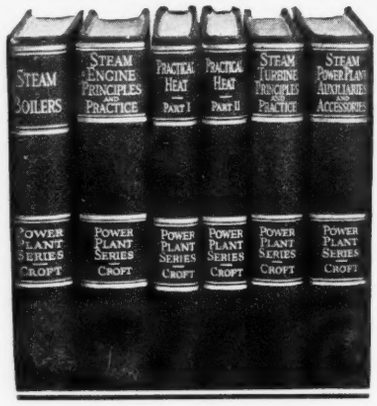
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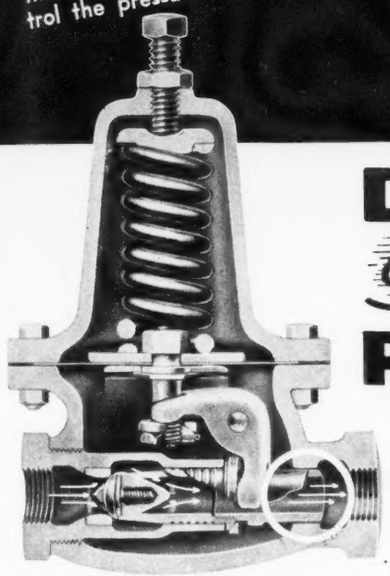

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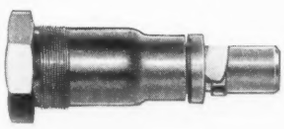

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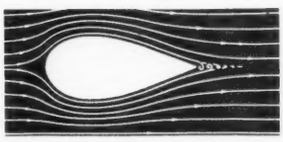

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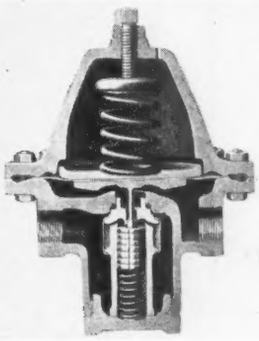

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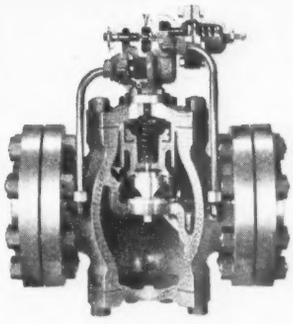

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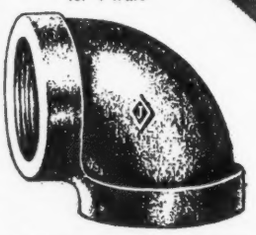

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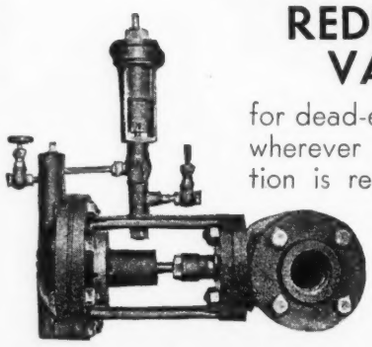

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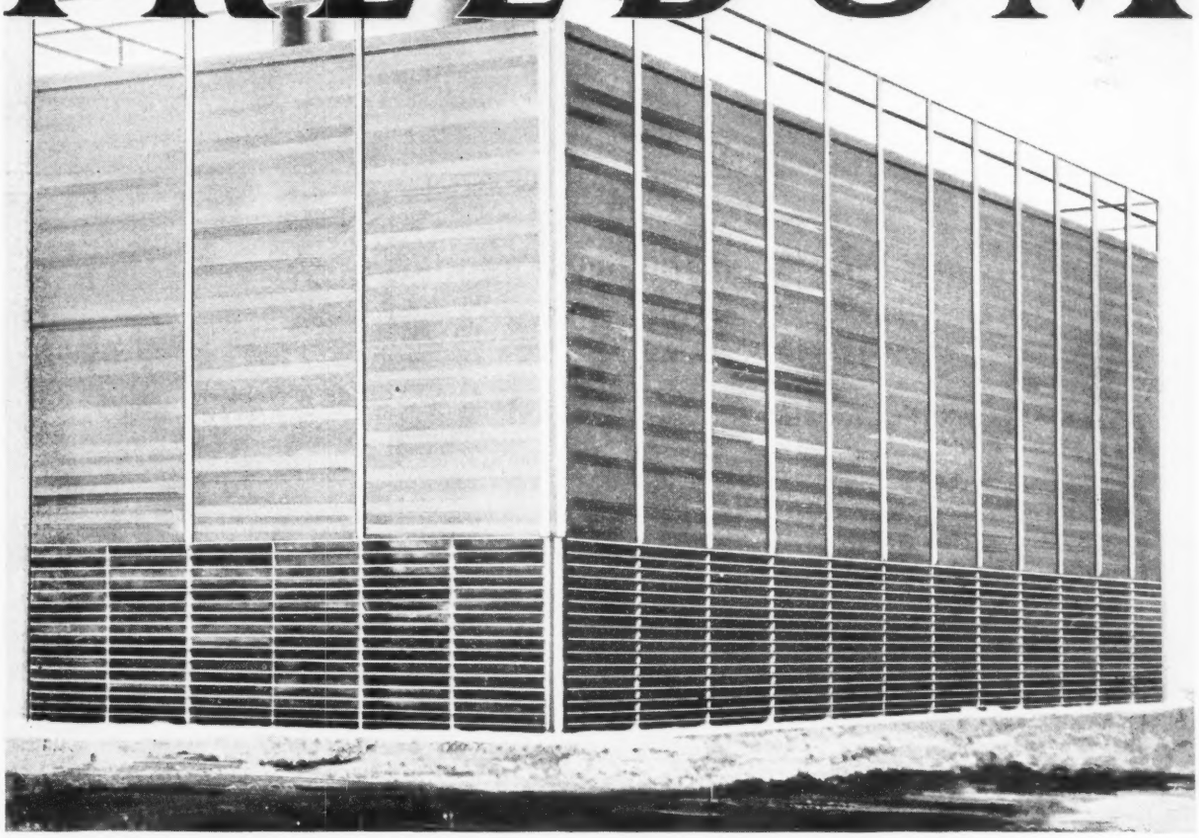

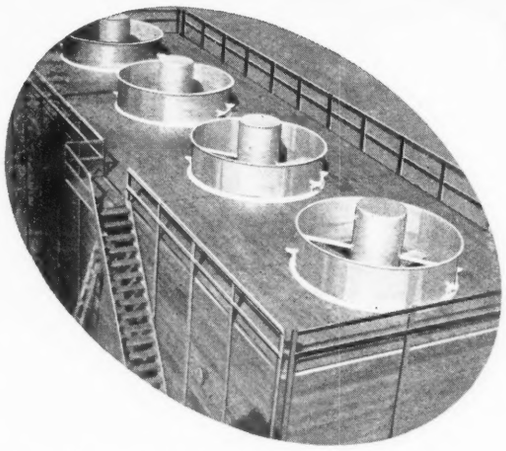

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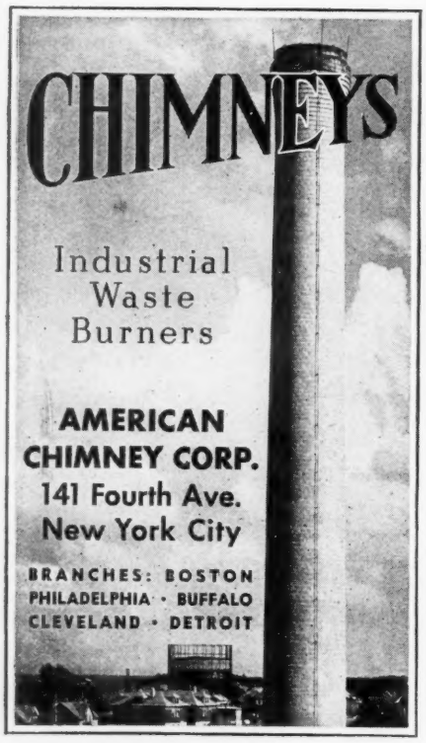

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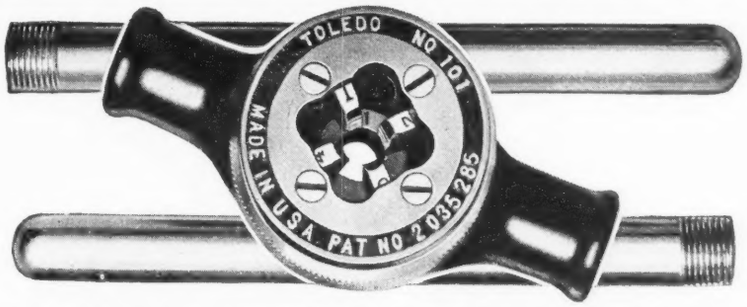

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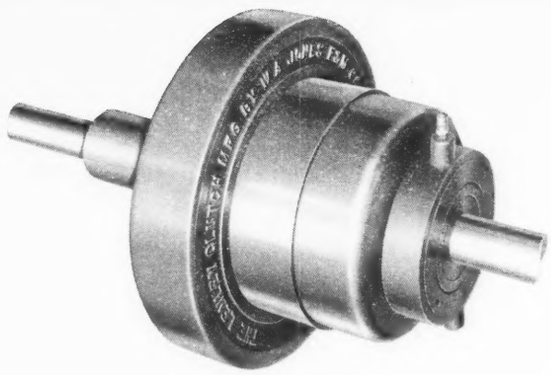

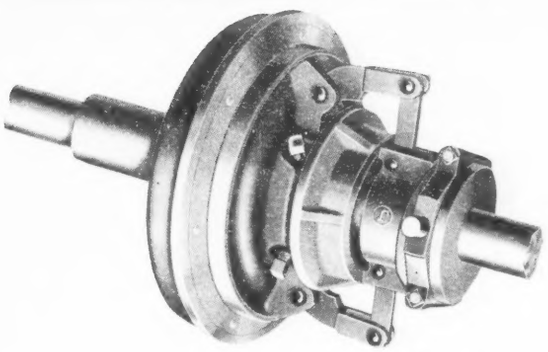

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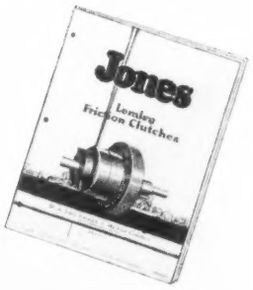

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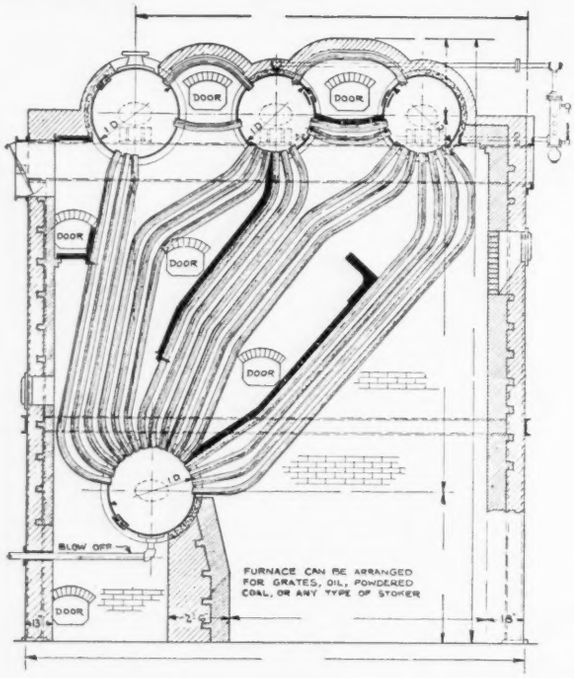

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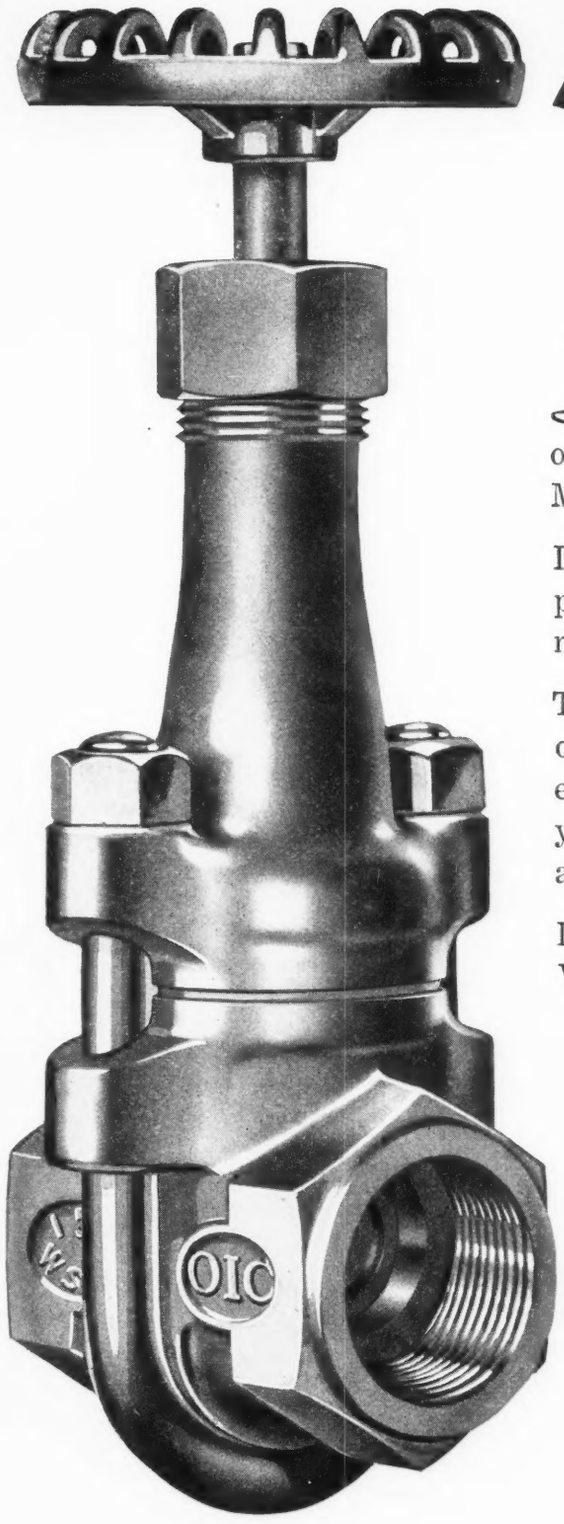

ASK FOR
FIGURE 333

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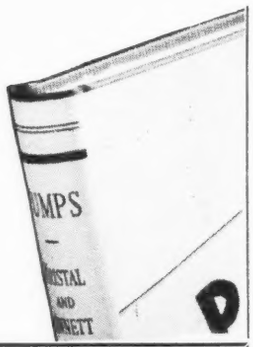

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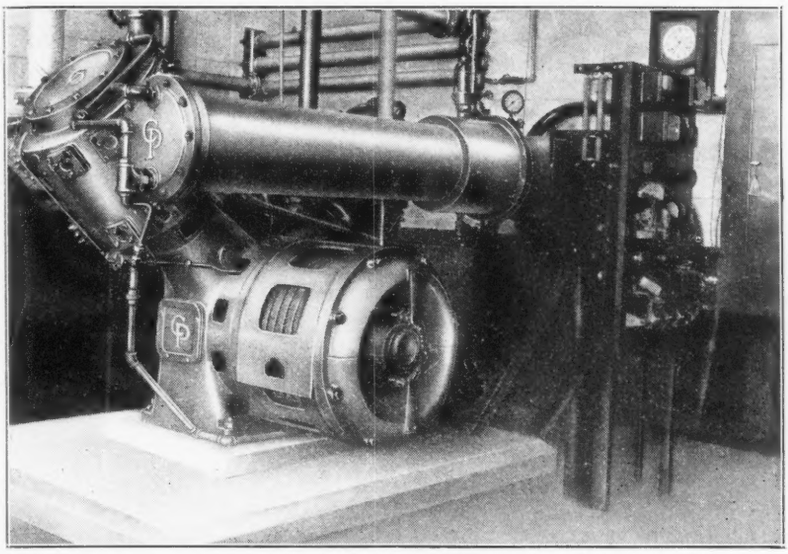

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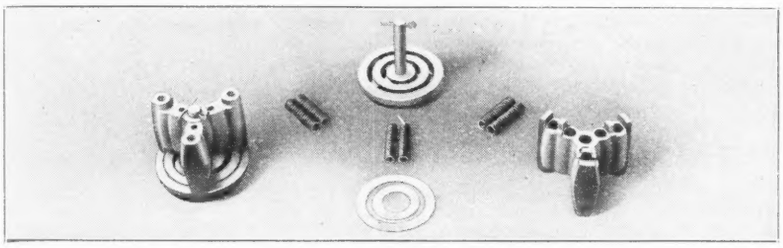

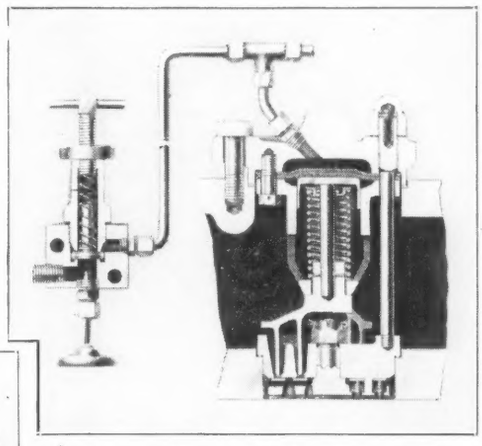

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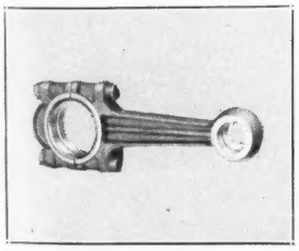

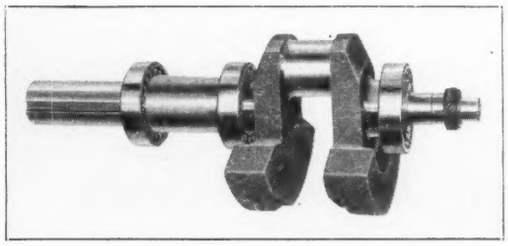

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How the fund is allocated . . . What it does in service

Every dollar that you give now to your Red Cross marches into the thick of things where humanitarian help is needed most—up to the fronts and battle stations where the fighting is heaviest. Into the Red Cross hospitals and First Aid units where prompt medical attention and supplies may save innumerable lives. And throughout our broad land to train and equip volunteers to meet any emergency that may strike.

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Provides for the care, welfare and morale of the Army and Navy, including services to men in hospitals and during convalescence. • Provides an important link between the service men and their families; keeps the families from breaking up, supplies food, shelter, medicine, and even jobs where necessary. • Provides essential medical and other supplies outside of standard Government equipment. • Operates Red Cross headquarters at camps and naval stations. • Enrolls blood donors and medical technologists for Army and Navy needs. • Provides millions of surgical dressings, sweaters, socks, etc. through volunteer workers.

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Supplies emergency needs for food, clothing, shelter and medical attention for disaster victims. • Assists stricken families in repair of homes and other adjustments; provides minimum reserves of essential relief supplies to prevent unnecessary delays.

CIVILIAN DEFENSE SERVICES • • • • • • • • $ 5,000,000

Trains volunteers for home nursing and nurses' aides. • Trains nurses, men and women, for active duty with the Army and Navy. • Trains volunteers in First Aid and accident prevention. • Trains volunteers for work in Motor Corps, Canteen and Production. • Instructs men, women and children in preparedness against explosive and incendiary bombs. • Organizes for evacuation of children and their families from stricken areas. • Assists Red Cross Chapters in establishing effective coordination of emergency relief with local and State defense authorities.

SERVICE AND ASSISTANCE THROUGH CHAPTERS • $ 4,000,000

Gives assistance and service to the 3,740 Red Cross Chapters with their 6,131 Branches responsible for local Red Cross activities, particularly welfare work among the service men and their families.

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Note to Red Cross Canvassers: Use the material on this page to better inform contributors how their donations are being expended.

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W-S Forged Steel Fittings in both welding and screw end types are available from distributors' stocks in a wide range of sizes and pressure ratings. The Watson-Stillman Co., Roselle, New Jersey.

Write us for Bulletin A-3— ***NOW!***

THEN call your nearest Mill Supply Distributor

WATSON-STILLMAN

Engineers and Manufacturers of Forged Steel Fittings and Valves, Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks

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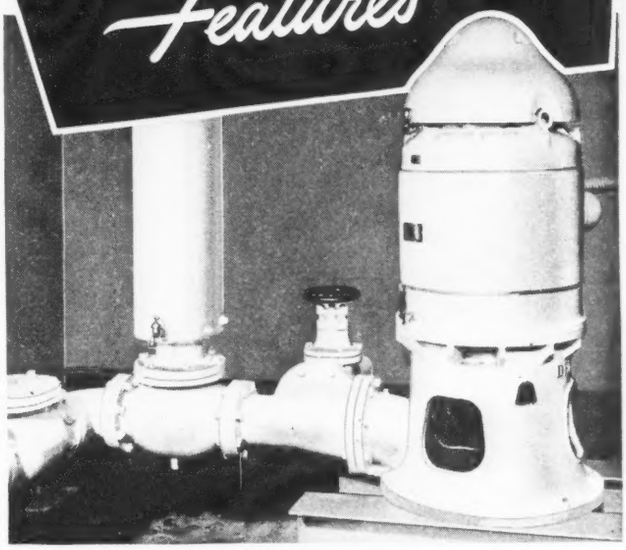
DEMING *Turbines have 7 Outstanding Features*



An engineering appraisal of Deming Deep Well Turbines reveals details of design and construction that combine to meet a wide range of exacting demands. At least seven of their many features are outstanding.

1. Separate motor shaft facilitates installation.
2. A non-reverse ratchet prevents pump from starting in wrong direction if improperly wired; also prevents backspin when current is turned off.
3. Stuffing Box is designed for several times normal working pressure to maintain high efficiency.
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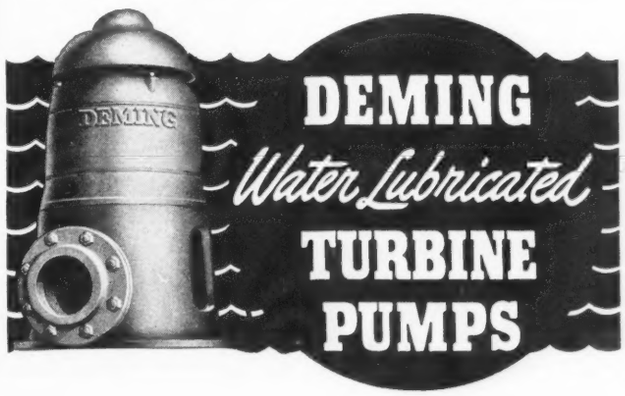
5. Column sleeve couplings are drive pipe type.
6. Stuffing Box Shaft is solid stainless steel and reversible.
7. Special Deming-designed pipe threading machine assures precision accuracy and uniformity of all threads having same taper and pitch.

Capacities of Deming Deep Well Turbine Pumps range from 10 to 2200 G. P. M. Standard or various secondary or combination heads are available. Bulletin 4700-8 gives complete details. Write for copy.

THE DEMING CO. • SALEM, OHIO



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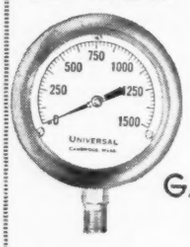

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GAUGE & VALVE
REPAIRS
UNIVERSAL STEAM GAUGE CO.
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for EVERY business WANT "Think SEARCHLIGHT first"

Equipment Wanted Advertising—page 280

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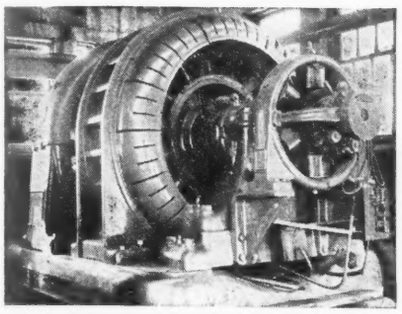
Step up your Power



MOTOR GENERATOR SETS

1—500 KW, 650 volt, General Electric, syn.
1—300 KW, 250 volt, General Electric, syn.
1—100 KW, 125 volt, Westinghouse, syn.
1—75 KW, 250 volt, synchronous.
1—100 KW, 125/250 volt, Allis Chalmers, squirrel cage.
1—50 KW, 250 volt, General Electric, sq. cg.
1—50 KW, 125 volt, Westinghouse, sq. cg.
1—35 KW, 125 volt, El. Mach., sq. cg.
1—25 KW, 125 volt, General Electric, syn.
1—20 KW, 125 volt, Burke, squirrel cage

D. C. GENERATORS

1—100 KW, 750 RPM, 125 volt, West. Elec.
1—100 KW, 600 RPM, 125/250 volt, G.E.
1—75 KW, 260 RPM, 250 volt, Westinghouse.
1—67½ KW, 700 RPM, 45 volt, Gen. Elec.
2—32 KW, 650 RPM, 125 volt, Westinghouse.

MOTORS—3 PHASE 60 CYCLE

1—720 HP, 360 RPM, 440 volt, G.E., syn.
1—500 HP, 450 RPM, 2200/4000 volt, G.E., slip ring.
1—400 HP, 514 RPM, 440 volt, Westg., sl. rg.
1—350 HP, 300 RPM, 440 volt, G.E., slip ring.
1—350 HP, 100 RPM, 220/440 volt, G.E. syn.
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—250 HP, 450 RPM, 220 volt, G.E., slip ring.
1—250 HP, 360 RPM, 440 volt, Westg. sq. cg.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—200 HP, 900 RPM, 440 volt, Westg., sl. rg.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—200 HP, 514 RPM, 4000 volt, G.E., syn.
1—175 HP, 900 RPM, 440 volt, Westg. syn.
1—150 HP, 1800 RPM, 2300 volt, Allis Chal. sq. cg.
1—150 HP, 900 RPM, 440 volt, Allis Chal. sl. rg.
2—150 HP, 720 RPM, 220 v., Elec. Mach. syn.
1—150 HP, 720 RPM, 440 volt, G E., slip ring.
1—150 HP, 600 RPM, 440 volt, G.E., slip ring.
1—150 HP, 400 RPM, 440 volt, G.E., sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., slip ring.
2—125 HP, 450 RPM, 440 volt, G.E., syn.
1—100 HP, 1800 RPM, 440 v., Allis Chal. sq. cg.
1—100 HP, 900 RPM, 220 volt, G.E., sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., slip ring.
3—100 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., slip ring.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.

MOTORS—3 PHASE 60 CYCLE—(Continued)

1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.
2—100 HP, 450 RPM, 440 volt, G. E., sq. cg.
1—75 HP, 1800 RPM, 220/440 v., G. E., sq. cg.
1—75 HP, 900 RPM, 4000 v., Elec. Mach. syn.
1—75 HP, 900 RPM, 440 volt, G.E., enclosed, fan cooled, squirrel cage.
1—75 HP, 900 RPM, 220 volt, Fairbanks-Morse, slip ring.
1—75 HP, 900 RPM, 2200 volt, G.E., slip ring.
1—75 HP, 514 RPM, 440 volt, G.E., sq. cg.
1—60 HP, 1750 RPM, 220 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

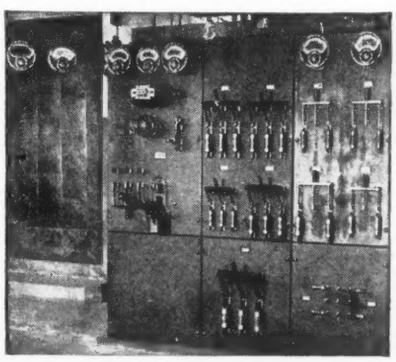
1—125 HP, 850 RPM, G.E., type CD.
1—125 HP, 550 RPM, General Electric.
1—100 HP, 1600 RPM, West., type SK.
1—65 HP, 1000 RPM, G. E., type RC.
1—50 HP, 1750 RPM, Westinghouse, type SK.
1—50 HP, 1100 RPM, Crocker Wheeler.
1—50 HP, 750 RPM, Westinghouse, type SK.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, 1100 RPM, G.E., type RC.
1—40 HP, 300 RPM, General Electric.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, 725 RPM, Westinghouse, type SK.

OIL CIRCUIT BREAKERS

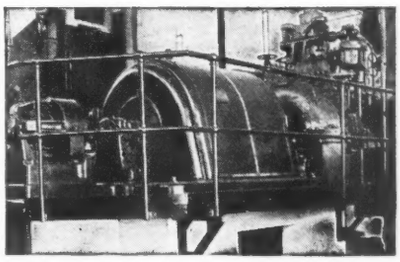
2—3000 amp., 15,000 v., 3 pole, G.E., type FK-130.
1—3000 amp., 600 v., 4 pole, G.E., type FK-24.
2—2000 amp., 15,000 v., 3 pole, G.E., type FK-53b.
1—1600 amp., 7500 v., 4 pole, Westg., B-2.
1—1500 amp., 440 v., 3 pole, Condit, D12.
1—1200 amp., 15000 v., 4 pole, Westg., B-2.
Also complete stock of small sizes.

ALTERNATORS

1—625 KVA, 450 RPM, 600 volt, Westg.
1—625 KVA, 3600 RPM, 600 volt, G.E.
1—400 KVA, 400 RPM, 240 volt, Westg.
1—375 KVA, 240 RPM, 2300 volt, Westg.
1—375 KVA, 200 RPM, 240 volt, Elec. Mach.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—100 KVA, 1200 RPM, 440 volt, G.E.
1—37½ KVA, 1200 RPM, 2400 volt, Westg.
1—15 KVA, 1800 RPM, 120 volts, G.E.



Switchboard Panel built by us for Synchronous Motor Generator Set



TRANSFORMERS

1—15,000 KVA, Pitts., 3 ph., 26,000/4150 v.
4—833 KVA, Allis Chal., 25 cy., 13,200/440 v.
3—400 KVA, Moloney, 13,800-220/440 volts.
2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—300 KVA, Pittsburgh, 4600-115/230 volts.
4—200 KVA, Pittsburgh, 7800-110/220 volts.
3—150 KVA, G.E., 33,000-2300/4000 Y.
3—150 KVA, Pittsburgh, 6600/440 volts.
12—150 KVA, G.E., 3 ph., 4150-120/208 v.
3—125 KVA, General Electric, 2300/480.
3—100 KVA, Westinghouse, 13200 250 volts.
3—100 KVA, G.E., 2400-240/480 volts.
3—100 KVA, Wagner, 2300-240/120 volts.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—50 KVA, Wagner, 4150-220 volts.
3—50 KVA, Westinghouse, 2200-220/110 volts.
4—50 KVA, Westg., air cooled, 440-220/220-110 v.
3—50 KVA, Westinghouse, 220-110/220 volts.
3—50 KVA, G.E., 2200-110/220 volts.
52—37½ KVA, 2200-220/110 v.
10—25 KVA, Westg., air cooled, 440/220-110 v.
3—25 KVA, Moloney, 2200-220/110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.
1—15 KVA, G.E., 440/110-220 volts.
12—15 KVA, Westg., air cooled, 440/220-220-110 v.
4—10 KVA, G. E., 2300-115/230 volts.
3—7½ KVA, G.E., 440-110/220 volts.

TURBO-GENERATORS

2—1000 KW, 3 ph., 60 cy., 2300/4150 v., cond.
1—625 KVA, Westinghouse, non-condensing.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—150 KW, 125/250 volt, Westg., non-cond.
1—100 KW, 125 volt, Westg., non-cond.
1—25 KW, 125 volt, Ridgeway, non-cond.

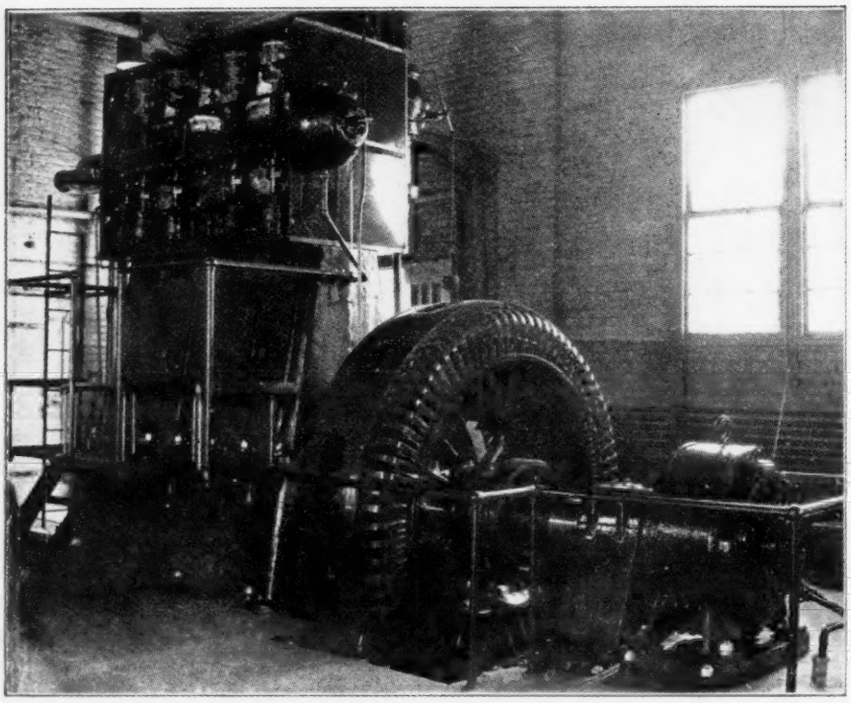
MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—75 HP, 235/950 RPM, Burke.
1—60 HP, 600/1200 RPM, General Electric.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—20 HP, 750/1500 RPM, General Electric.
1—5 HP, 600/1200 RPM, General Electric.
6—5 HP, 400/1200 RPM, Westinghouse.
1—5 HP, 225/900 RPM, Electro Dynamic.
1—5 HP, 600/1800 RPM, General Electric.
1—3 HP, 500/2000 RPM, Westinghouse.

J. L. HEMPHILL & CO., INC., Power Equipment

New York Phone: LOngacre 5-3227 — 1602 53rd ST., NORTH BERGEN, N. J. — New Jersey Phone: PAlisade 6-2600

ELECTRICAL POWER



Actual Photograph

625 KVA AMES VERTICAL UNIFLOW UNIT

625 KVA Westinghouse alternating current generator, 3 phase 60 cycle 2300/600/480/240 volts 300 RPM direct connected to 14"x16" Ames 4 cylinder vertical uniflow non-condensing engine, 150-175 lbs. steam pressure 0-5 lbs. back pressure. Complete with exciter and switchboard

Can be shown in operation

ENGINE GENERATORS

3 Phase 60 Cycle

625 KVA WESTINGHOUSE - AMES 4 cylinder vertical Uniflow, 150-175 lbs. 0-5 lbs. back pressure, 2300/600/480/240 volts.

500 KVA GENERAL ELECTRIC-AMES 4 cylinder vertical Uniflow, 150-175 lbs., 0-10 lbs. back pressure, 2300/600/480/240 volts.

438 KVA GENERAL ELECTRIC-SKINNER Uniflow, 150-175 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

210 KVA GENERAL ELECTRIC-AMES Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

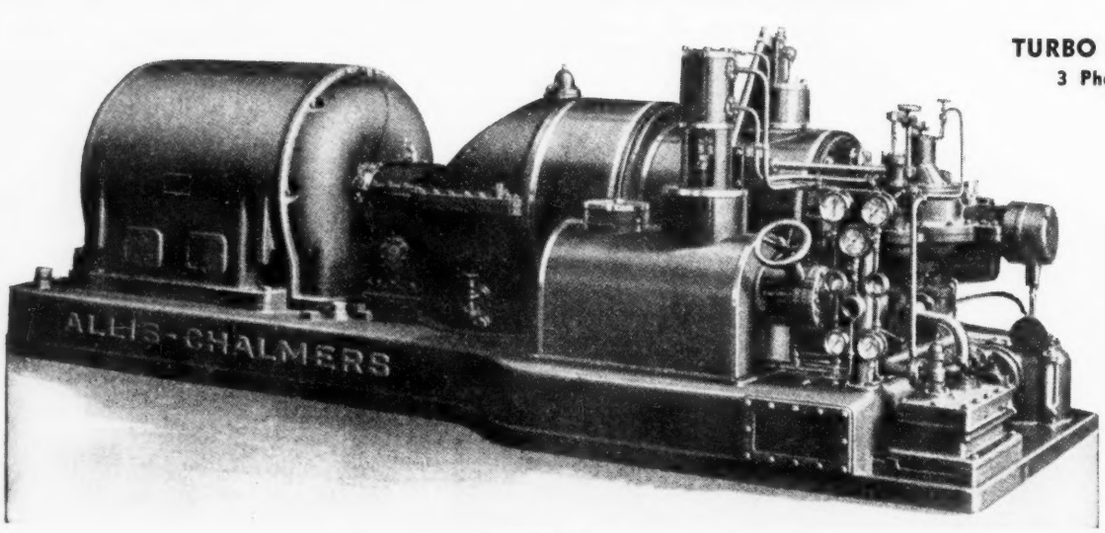
210 KVA (2) GENERAL ELECTRIC - SKINNER Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

ENGINE GENERATORS

125/250 Volts 3-Wire D.C.

150 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.

125 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.



Actual Photograph

1000 KW ALLIS CHALMERS CONDENSING TURBO UNIT

1000 KW 80% P.F. 1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to 1000 KW Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

TURBO GENERATORS

3 Phase 60 Cycle

5000 KVA GENERAL ELECTRIC condensing, 150 lbs., with surface condenser; 6600 volts.

2500 KVA WESTINGHOUSE condensing, 125-150 lbs., with surface condenser; 600 volts.

1250 KVA ALLIS CHALMERS condensing, 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.

500 KVA WESTINGHOUSE non-condensing, 175 lbs. pressure, 0-5 lbs. back pressure; 2400 volts.

THE NATIONAL POWER

WER EQUIPMENT

ROTARY CONVERTERS

60 Cycle

3500 KW (2) WESTINGHOUSE, 225-285 volts D.C., 225 RPM with 3 phase 60 cycle 13200 volt transformers.

2500 KW WESTINGHOUSE, 600 volts D.C., 400 RPM with 3 phase 60 cycle 11000 volt transformer.

1500 KW WESTINGHOUSE, 225-285 volts D.C., 450 RPM with 3 phase 60 cycle 2300/4000-6900/12000 volt transformers.

1500 KW (2) WESTINGHOUSE, 600 volts D.C., 720 RPM with 3 phase 60 cycle 33000 volt transformers.

1000 KW (2) WESTINGHOUSE, 600 volts D.C., 900 RPM with 3 phase 60 cycle 12000 volt transformers.

750 KW GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 2300 volt transformers.

500 KW (2) GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 13200 volt transformers.

300 KW WESTINGHOUSE, 250 volts D.C., 600 RPM with 3 phase 60 cycle 2300 volt transformers.

ROTARY CONVERTERS

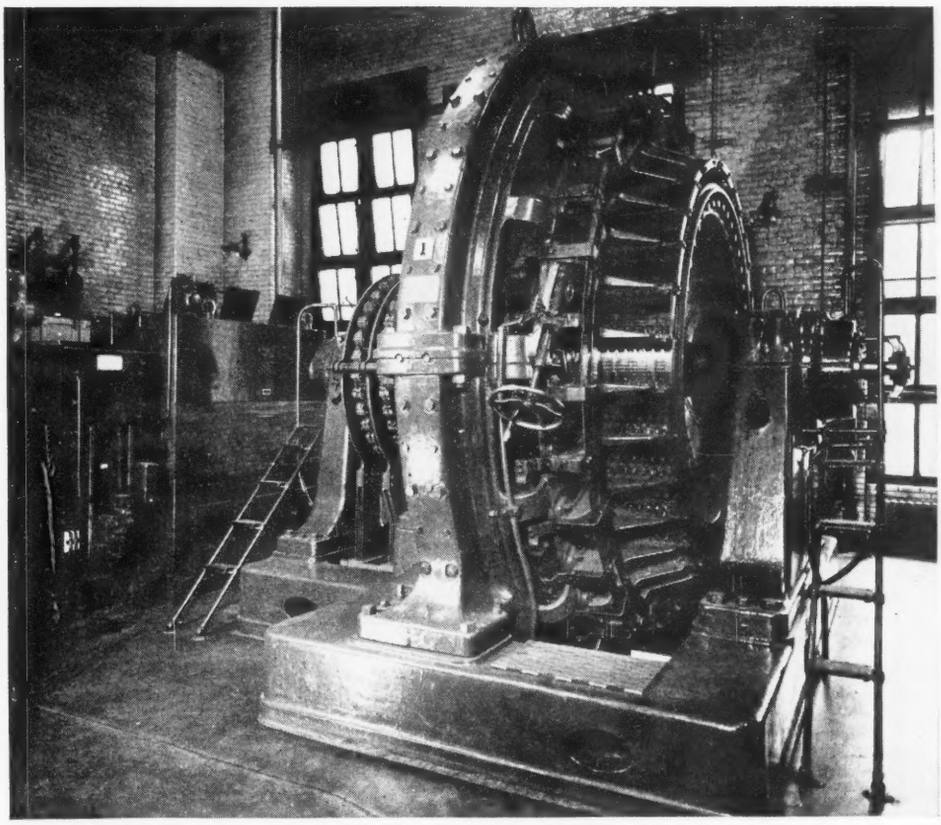
25 Cycle

2000 KW WESTINGHOUSE, 250-300 volts D.C., 300 RPM with 3 phase 25 cycle transformer any voltage.

1500 KW (2) GENERAL ELECTRIC, 600 volts D.C., 300 RPM with 3 phase 25 cycle 11000 volt transformers.

1500 KW (3) WESTINGHOUSE, 600 volts D.C., 250 RPM with 3 phase 25 cycle 6600 volt transformers.

1000 KW GENERAL ELECTRIC, 250 volts D.C., 214 RPM with 3 phase 25 cycle 6600 volt transformer.



Actual Photograph

3500 KW WESTINGHOUSE ROTARY CONVERTER

3500 KW (2) Westinghouse booster type interpole rotary converters, 225-285 volts D.C. 225 RPM; 6 phase 60 cycle A.C. with 3 phase 60 cycle 13200 volt transformers. Complete with control.

Can be shown in operation

MOTOR GENERATOR SETS

3 Phase 60 Cycle

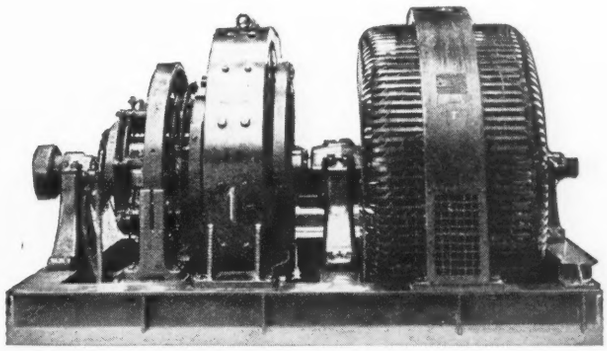
1000 KW GENERAL ELECTRIC synchronous, 125-250 volts 3-wire D.C.; 3 phase 60 cycle 13200 volts A.C., 720 RPM.

1000 KW GENERAL ELECTRIC synchronous, 275 volts D.C., 3 phase 60 cycle 6600 volts A.C., 514 RPM.

750 KW GENERAL ELECTRIC synchronous, 600 volts D.C., 3 phase 60 cycle 4000 volts A.C., 720 RPM.

400 KW GENERAL ELECTRIC induction, 250 volts D.C., 3 phase 60 cycle 2200 volts A.C., 600 RPM.

150 KW WESTINGHOUSE synchronous, 250 volts D.C., 3 phase 60 cycle 2300 volts A.C., 900 RPM.



1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1000 KW GENERAL ELECTRIC direct current generator, 125/250 volts, 3-wire, 720 RPM., direct connected to 1400 HP 80% P.F. General Electric synchronous motor, 3 phase 60 cycle 13200/6600 volts, 720 RPM. Equipped with D.C. breakers. Can be shown in operation.

R MACHINERY CO. 1921 SCRANTON RD. CLEVELAND, OHIO

POWER PLANT MACHINERY

Available Immediate Delivery

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

2500 KVA ALLIS condensing 200 lb. pressure, 100° S.H., 600 volts, 3600 RPM complete with surface condenser.

1563 KVA WESTGH. condensing 200 lb. pressure, 100° SH, 2400 or 550 volts, 3600 RPM complete condenser and auxiliaries, switchboard and instruments.

937 KVA G.E. condensing 200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with Ingersoll-Rand condenser, exciter, switchboard and instruments.

937 KVA (2) WESTINGHOUSE automatic extraction condensing, 150 to 200 lb. pressure, 10 lb. gauge back pressure, 480 volts, 3600 RPM, complete condensers, exciters, switchboards and instruments.

937 KVA ALLIS condensing 200 lb. pressure, 100° SH, 2300-550-480 volts, 3600 RPM complete surface condenser with auxiliaries, direct connected exciter—Modern and practically new.

937 KVA WESTINGHOUSE non-condensing, 175-200 lb. pressure, 10 lb. back pressure, 480 volts, 3600 RPM, complete motor driven exciter set, switchboard and instruments.

937 KVA ALLIS condensing 150 to 200 lb. pressure, 475° TT, 2300 volts, 3600 RPM, complete with direct connected exciter, surface condenser and auxiliaries.

750 KVA G.E. condensing, 150-200 lb. pressure, 2300 volts, 3600 RPM, complete surface condenser and exciter set.

375 KVA G.E. condensing 225 lb. pressure, 150° S.H., 2300 volts, 3600 RPM, complete direct connected exciter, Manistee jet condenser with auxiliaries.

112 KVA TERRY-ALLIS CHALMERS non-condensing 175-200 lb. pressure, 0.8 lb. back pressure, 480 volts, 3600 RPM, complete direct connected exciter, switchboard and instruments.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

1125 KVA G.E. 480 volts, 150 RPM direct connected 24"x46"x33" Erie-Ball cross compound engine, complete exciter, and rheostats.

500 KVA G.E., 240/480 volts, 150 RPM direct connected 26"x32" Skinner Universal Unaflow non-condensing engine, 130-160 lb., 6 lb. back pressure, complete exciter and rheostats.

500 KVA G.E. 240 volts, 120 RPM direct connected 20"x42" Rice Sargent Corliss non-condensing engine, 125-150 lb., 10 lb. back pressure.

ENGINE-GENERATOR UNITS Continued

438 KVA G.E. 240/480 volts, 150 RPM direct connected 24"x30" Chuse N.R.C. non-condensing engine, 125-150 lb. pressure, 5 lb. back pressure.

Direct Current

1500 KW WESTINGHOUSE 250 volts, 360 RPM generator direct connected by reduction gear to a Westinghouse condensing turbo generator unit complete with auxiliaries.

500 KW CROCKER WHEELER 250 Volts, 300 RPM direct connected Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 6 lb. gauge back pressure, complete switchboard and instruments.

300 KW WESTINGHOUSE 250 volts, 175 RPM direct connected 24"x26" Skinner Unaflow non-condensing engine, 110-150 lb. pressure, 5 lb. back pressure, complete switchboard and instruments.

250 KW CROCKER-WHEELER, 250 volt, 180 RPM direct connected to a 20" x 24" Skinner Universal Unaflow non-condensing engine, 175-200 lbs. 0 to 10 lbs. back pressure, complete switchboard panels and instruments.

200 KW G.E., 125 volt, 200 RPM direct connected 18"x24" Erie Ball non-condensing engine, 135-150 lb. pressure.

100 KW GENERAL ELECTRIC, 125 volts, 250 RPM direct connected Skinner Universal Unaflow non-condensing engine, complete switchboard and instruments.

65 KW GENERAL ELECTRIC 125 volt, 1100 RPM, direct connected Terry non-condensing turbine, 125-150 lb., 5 lb. gauge back pressure.

50 KW WESTINGHOUSE 125 volt, 1750 RPM, direct connected Westinghouse non-condensing turbine, 225 lb. pressure, 150° F-SH, 3 lb. back pressure.

20 KW G.E. 125 volt, 4500 RPM, 175 lb. pressure non-condensing turbine-generator unit.

MOTOR GENERATOR SETS

1500 KW ALLIS 600 volt direct current generator direct connected to a 2190 HP, 3 phase, 60 cycle, 4000 volt, 300 RPM synchronous motor.

1000 KW G.E. 575 volts direct current generator direct connected 1430 HP, 3 phase, 60 cycle, 4000 volt, 514 RPM synchronous motor.

750 KW G.E. 550 or 275 volt, direct current generator direct connected 1075 HP 90% P.F., 3 phase, 60 cycle, 4000 volt, 514 RPM synchronous motor.

20 KW G.E. 125 volts direct current generator direct connected 25 HP, 3 phase, 60 cycle, 220 volts, 1200 RPM motor.

MOTORS

3 phase, 60 cycle

800 HP, WESTGH. 440 V., 240 RPM synchronous.

620 HP G.E. type ATI, form S, 440 volt, 164 RPM synchronous.

400 HP, G.E. type TS, Form AL, 440 V. 300 RPM synchronous.

400 HP, WESTINGHOUSE type CW, 440 V., 500 RPM, slip ring.

300 HP, 80% P.F. WESTINGHOUSE 2300 V., 200 RPM synchronous.

250 HP, ALLIS-CHALMERS 440 V., 600 RPM synchronous.

125 HP, (3) 80% P.F. Elec. Mchy. 440 V., 400 RPM synchronous with starting equipment.

125 HP, 80% P.F. Elec. Mchy. 440 V., 514 RPM synchronous.

75 HP, E.M. CO. 2300 V., 1200 RPM slip ring.

50 HP, type I, form M, 3 phase, 60 cycle, 2200 volts, 1200 RPM slip ring.

50 HP, (2) G.E. form K, 220 V., 900 RPM squirrel cage.

22 HP, G.E. type ITC, 440 V., 1200/600 RPM, slip ring.

MISCELLANEOUS

1 WESTINGHOUSE frequency changer set consisting of a 655 HP, 3 phase, 25 cycle, 2200 volt, 300 RPM synchronous motor direct connected to 565 KVA 80% P.F., 3 phase, 60 cycle, 240 volt alternating current generator complete and equipped with direct connected exciters, all panels with instruments—practically new.

250 KW CROCKER-WHEELER 250 volt, 600 RPM compound wound interpole direct current generator.

1500 KVA, 3 phase, 60 cycle, 22,000 volt primary, 2300 volt secondary WESTINGHOUSE transformer.

900 KW G.E. 3 phase, 60 cycle, 480 volt, 150 RPM alternating current generator with exciter.

500 KVA IDEAL, 3 phase, 60 cycle, 240 volts, 400 RPM, three-bearing belted type generator with direct connected exciter and rheostats.

312 KVA WESTINGHOUSE, 3 phase, 60 cycle, 2300 or 220 volts, 200 RPM, engine type generator with belt driven exciter and rheostats.

200 KVA WESTINGHOUSE, 3 phase, 60 cycle, 240 volts, 200 RPM engine type generator with rheostat.

150 KVA G.E. 3 phase, 60 cycle, 440 volt, 900 RPM belted alternator.

1 ELLIOTT EHRHART jet condenser with all auxiliaries suitable for operation with a 5000 KW turbine-generator unit.

1500 sq. ft. WESTINGHOUSE surface condenser.

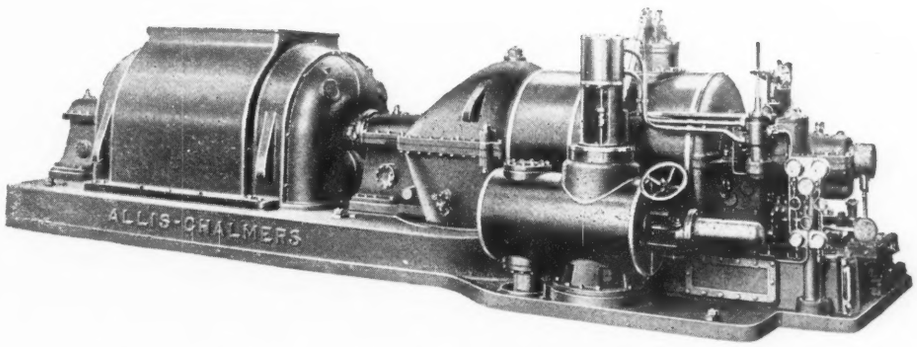
1055 cubic feet, 100 lb. air pressure CHICAGO PNEUMATIC horizontal compressor direct connected to 170 HP, 240 V., 150 RPM General Electric direct current motor.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO
WIRE OR PHONE
LONG DISTANCE 422

DEPENDABLE

Turbo-Generators

It is the Practice of this Company to Confine its Inventory Strictly to Comparatively Modern, Little Used Turbines Some Are Practically New



2—Allis-Chalmers, 2500-KVA, 3/60/600-volt, 200#-P, 500°F-TT, Surface Condensers

PART OF OUR INVENTORY—BELOW

1—G.E., 7500-KVA, 3/60/600-2300-v, 250# 575° Maximum. Surface Condenser.

1—G.E., 5000-KVA, 3/60/2300-v, 250# 550° F. Surface Condenser.

1—Allis-Chalmers 4000-KVA, 3/60/2300-v, 200#, 500°-F, TT, Condensing.

1—G.E., 1875-KVA, 3/60/480-v, 200#, 500°, Condensing.

1—G.E., 1563-KVA, 3/60/2300-v, 175#, 100° SH, 28". Surface Condenser.

1—Westinghouse, 1563 KVA, 3/60/2400 volts, 200#, 100° SH. Condensing, Modern.

1—Allis-Chalmers 1250-KVA, 3/60/2300-v, 200#, 500° TT. Surface Condenser.

1—G.E., 1250-KVA, 3/60/480-v, 175#-P and 16# Abso. Mixed Pressure.

1—G.E., 937-KVA, 3/60/2300-v, 200#, 500°-TT, 3-Stage Condensing.

1—Allis-Chalmers, 937-KVA, 3/60/2300-v, 200#, 500°-TT, Condensing Surface Condenser.

1—G.E., 625-KVA, 3/60/2300-v, 200#, 500°TT. Condensing.

1—G.E., 625-KVA, 3/60/600-v, 250#, 550°F-TT, Condensing Modern.

WILMS, WEAVER & CO. Union Guardian Bldg. DETROIT, MICH.

We Deal In Turbo-Generators Exclusively

AVOID COSTLY EQUIPMENT DELAYS

Specify **CHICAGO ELECTRIC GUARANTEED REBUILT POWER EQUIPMENT**

ITEMS LISTED ARE BUT A FEW FROM OUR COMPLETE STOCK SPECIALLY PRICED FOR QUICK SALE

MOTOR-GENERATOR SETS

1—800 KW Elliott, type 401628, 250 v. comp. intpl. DC gen. (equipped with compensating winding) with 1000 HP .8 p.f. 3/60/2300/440/220 v. syn. motor, 720 RPM, 3-brg.
1—500 KW G.E. type MPC, 600 v. comp. intpl. d.c. gen. 3-brg. with 720 HP type ATI syn. motor .8 p.f. 3/60/4400/2200 v. 720 RPM.
1—500 KW National, 250/275 v. type MD, comp. intp. DC gen. 3-nrb. 750 HP National MD 3/60/4400/2300 v. syn. motor, 600 RPM.
1—300 KW G.E. 250/275 v. comp. intpl. d.c. gen. 3-brg. with 450 HP G.E. type I form K 3/60/2300/440/220 v. ind. 720 RPM.
1—300 KW 250 v. 3-wire, 2—150 KW G.E. type MP, 125 v. d.c. gens. with 500 KVA G.E. ATI 3/60/4400/2200 v. unity pf. syn. motor, 720 RPM.
2—300 KW 600/650 v. type MPC, comp. intpl. d.c. gens. 3-brg. with 435 HP ATI syn. motors, .7 p.f. 3/60/11000/2300 v. 720 RPM.
1—235 KW Westinghouse, 115 v. type SK, comp. intpl. d.c. gen. 3-brg. with 360 HP Wtg. 3/60/2300 v. 900 RPM l. p.f. syn. motor.
1—225 KW Ideal, type D, 115 v. comp. intp. d.c. gen. 3-brg. with 322 HP Ideal, type SMS, 3/60/2300 v. 900 RPM, l. p.f. syn.
1—200 KW, consisting of 2—100 KW G.E. type MP, shunt, 70 v. DC gens. 4-brg. with 300 HP 3/60/2200/440/220 v. ind. or syn. motor 720 RPM.
1—200 KW, consisting of 2—100 KW G.E. MP, shunt, 70 v. d.c. gens. 4-brg. with 300 HP G.E. 250 v. shunt d.c. motor, 425 RPM.
1—200 KW Elliott, 125 v. comp. intp. d.c. gen. 3-brg. with 300 KVA G.E. type ATI .8 p.f. syn. 3/60/440 v. 900 RPM.
1—150 KW G.E. (Sprague) 250 v. type C75, shunt, intp. DC gen. with 200 HP Elec. Machy. syn. motor 3/60/2300/440/220 v. unity, 1200 RPM.
1—150 KW Westinghouse, 275 v. type SK10 (150% 2-hrs. 55-deg. 100% 24 hrs. 35-deg.) comp. intpl. d.c. gens. with 217 KVA syn. .8 p.f. 3/60/2200/440/220 v. 1200 RPM.
1—150 KW Westinghouse, type SK, 275 v. comp. intpl. d.c. gen. with 225 HP syn. unity pf. 3/60/2300 v. 3-brg. 900 RPM.
1—150 KW General Electric, type MPC, 600 v. DC. gen. 3-brg. with 225 HP G.E. ATI 3/60/2300/440 v. syn. motor, .8 p.f. 1200 RPM.
1—100 KW Ideal, 115 v. comp. intpl. type D DC. gen. 3-brg. with 150 HP Ideal type SMS 3/60/2300/440 v. syn. .8 p.f. 1200 RPM.
1—100 KW G.E. 250 v. comp. intpl. type MPL, d.c. gen. Link-belt driven to 150 HP Ideal SMS syn. motor 3/60/220 400 RPM.
1—100 KW Burke, type 36C, 115 v. comp. d.c. gen. 4-brg. with 150 HP Allis Chal., 3/60/220 v. ind. 700 RPM.
1—100 KW Westinghouse, 275 v. type SK, 40-deg. C. (125# ol 2 hrs. 55-deg.) comp. intpl. d.c. gen. with 150 HP syn. motor unity pf. 3/60/2300 v. 3-brg. 900 RPM.
1—100 KW G.E. type DLC-206, 250 v. comp. intpl. d.c. gen. 3-brg. with 150 HP type I, form K, 3/60/2300 v. ind. 870 RPM.

SQUIRREL CAGE

Qn.	HP.	Make	Type	Speed
1	800	Westghse.	CS1023	1750
1	200	Gen. Elec.	IK	580
1	200	Westghse.	CS	580
1	150	Westghse.	CS	1175
1	150	Allis Chal.		1170
1	125	Gen. Elec.	KT-547	1800
1	125	Cr. Wheeler	SC-24A	880
1	125	Gen. Elec.	IK	580
1	100	Gen. Elec.	IK	1200
1	100	Westghse.	CS	1160
1	100	Gen. Elec.	IK	900
1	75	Allis Chal.		865

SQUIRREL CAGE—Continued

Qn.	HP.	Make	Type	Speed
1	75	Gen. Elec	KT-356	690
1	60	Westghse. bb.	CS-504S	1800
1	60	Fynn-Welsch'l	26VRN	1200
1	60	American bb.	self-cooled	870
1	50	Howell bb.	FBB-44-5	1725
1	50	Watson	KH-14	1720
1	50	Westghse.	CCL	900
1	50	Gen. Elec.	KT-342	870
1	50	Gen. Elec.	KT-346	870
1	50	Westghse.	CCL	850
1	50	Gen. Elec.	I-K	490
1	40	Wagner	22TBP	1800
1	40	Gen. Elec.	KF-444Y	1745
1	40	Gen. Elec.	IK	1200

SLIPRING MOTORS
3 Phase, 60 Cycle

HP.	Make	Type	Speed
2850	Westghse.	CW 1-brg.	450
2000	Westghse.	CW	505
1500	Gen. Elec.	MT-24	300
1500	Allis Chal.	ANY	485
800	Westghse.	CW	443
800	Westghse.	CWB4	360
600	F.-Morse (2)		1800
600	Crocker-Wheeler		505
550	Crocker-Wheeler		1170
500	Gen. Elec.	IM (3)	600
450	Westghse.	CW	500
400	Gen. Elec.	IM	360
400	Gen. Elec.	MT412	514
400	Gen. Elec.	IP	1200
350	G. E. dustproof	MT423Y	300
350	Allis Chal.	double sht.	300
350	Allis Chal.		505
350	Westghse. (2)	CW1214A	350
350	Allis Chal. (2)		500
300	Gen. Elec.	IM	514
300	Gen. Elec.	MT561	1800
250	Allis Chal.		294
250	Gen. Elec.	IP	450
250	Gen. Elec.	IM	1175
225	Gen. Elec.	IM	600
200	Gen. Elec.	IL (2)	600
200	Westghse.	CW	580
200	Westghse.	CS1106	345
150	Wagner	S1X5BR	1140
150	Allis Chal.	ANY	870
150	Gen. Elec.	IM	600
150	Westghse.		700
150	Gen. Elec.	IM	585
125	Gen. Elec.	MT-558	900
104	Gen. Elec.	IM	860
75	Gen. Elec.	IQ 2 ph.	1800
75	Westghse.	F	690
75	Gen. Elec.	IM	600
60	Gen. Elec.	MT-343	1155
60	Allis Chal. (2)	ARY-223D	865
60	Westghse. (4)	CW-774C	575
50	Westghse. (4)	HF-11AH	1180
50	Westghse.	CW	1160
50	Allis Chal.		1160
50	Cr.-Wheeler	121Q	1160
50	F.-Morse	HBC12D	900
50	Westghse	CW	870
50	Westghse.	HF12AH	865
50	Gen. Elec.	MT-346	865
50	Cr.-Wheeler	SR-21Q	860

FEED WATER HEATER

Hoppes exhaust steam feed water heater, class R, size E, cast iron construction, 5000 HP, working pressure 10 lbs. per sq. inch gauge.

BOILER FEED PUMP

1—Worthington, size 12"x7½"x15", 300# water pressure, 175 lb. steam pressure, brass bushed stuffing boxes and glands, duplex plunger type.

A.C. GENERATORS

KVA	Make	Type	Volts	PF	Spd
2.4	G.E.	T24DL	110		860
4	G.E.	TLA-FL	110		860
10	Cr. Wh.	1oJ	220/440	1.	1800
12½	G.E.		220		1800
37½	G.E.	2-brg.	220/440		1200
125	Westg.		2300/550	.8	900
125	Westg. eng. type		2400		327
125	Westg.		220/440	.8	900
175	Westg.	2-brg.	2200	1.	900
200	Westg.	2-brg.	220/440	.8	600
200	Westg.		2300/550	.8	600
200	W.-Elec.	2-brg.	220/440		450
200	G.E.	2-brg.	220/440	1.	720
240	G.E.	3-brg.	220/440	.8	720

ENGINE GENERATOR SETS

1—3 KW Universal, compound, 143 v. gas engine, with gas motor, 1160 RPM.
1—10 KVA Northwestern HC 3 phase, 60 cycle, 480 v. 1800 RPM, a.c. gen. driven by 4-cylinder Chevrolet gasoline engine, V-belt-driven all mounted on fabricated base, with exciter.
1—50 KW Westinghouse, .8 p.f. 3/60/440 v. a.c. generator, with 11x12 Skinner unaflow engine, 140# pressure.
1—80 HP International Diesel engine only, type PDS0 1400 RPM.
1—100 HP VanBlerck 6-cylinder gasoline engine, 1200 RPM, can furnish with AC or DC generator, direct-connected, if desired.
1—500 HP Winton, 8 cylinder gas engine, 1100 RPM, overhead valve type.
1—500 HP Winton 8 cylinder gas engine, 1100 RPM overhead valve type, can furnish with 400 KVA Westinghouse, .9 p.f. 3/60/2300 v. a.c. generator.
1—250 KW Corliss-Clark steam engine, 20x20, connected to Woods generator, 3/60/440 volts, with belted exciter.
1—500 KW General Electric, type MPC, 250 volts, d.c. generator, with Skinner engine, 150 RPM.
1—800 KW General Electric, type ATB, 3/60/480 v. a.c. gen. no back press. 150 RPM, with chain-driven exciter, direct-connected to Skinner Universal unaflow engine, heavy duty, side crank, horiz. bored guide, automatic.

FREQUENCY CHANGERS

1—90 KW General Electric adjustable frequency set, consisting of a 60 HP 3/60/220 v. 4-speed motor, with motor starting compensator and pole changing switch, motor direct-coupled to a 3 phase frequency changer, rated as follows: 90 KW 60/120 cycles, 70 KW 60/100 cycles, 68 KW 60/90 cycles, 60 KW 60/80 cycles.
1—500 KVA Westinghouse, with 583 HP 3/25/2300/575/440/220 volts, 750 RPM synchronous motor, driving 500 KVA 3/62½ cycle, 2300/460/220 volts synchronous generator, both machines equipped with amortisseur windings, and can be operated from 60 cycle current to furnish 24 cycles.

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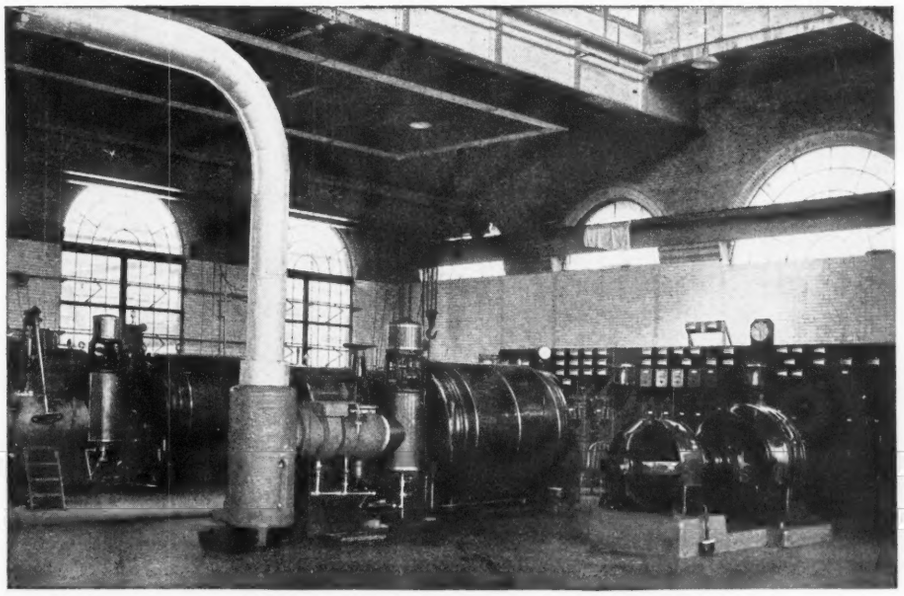
This complete Power Plant is now ready for immediate delivery. No priorities.



Recently installed, designed for high fuel economy, flexibility of operation, high electrical efficiency.

One Corner of Generator Room

Modern — Set up as operated — Excellent condition

BOILERS

3—1046 B.H.P. Wickes Cross Drum Water Tube Boilers, ASME, Mass. Standard, Boiler pressure 250# — good for 200% rating. Equipped with Combustion Eng. Co. slag screens, air cooled walls, Lopulco arches, coal feeders, fish tail burners; and 55 ton steel plate air jacketed and warmed bunkers with circulating fans. Equipped with Superheater Co. superheaters for 100° F.

Pulverized Coal Bin System for Wickes Boilers consisting of:
1—50 ton per hour Coal Crusher, M.D.
1—50 ton per hour elevating and scraper Conveyor, M.D.
1—Richardson automatic scales and magnetic separator.
1—350 ton coal Bin.
3—Sets, 5 tons per hour Raymond Roller Mill, Exhausters, Driers, Cyclone Collectors and Screw Conveyors, all motor driven.
1—Cochrane 360,000± per hour Deaerating Heater and Vent Condenser.

Boiler House Equipment consisting of:
Ash handling and Conveying equipment, Testing tanks, Weighers, Soot blowers. Complete metering equipment, Recorders, Gauges, Regulators, boiler feed Pumps, etc.

TURBO GENERATORS

1—3500 K.W. General Electric Co. Bleeder Type, Turbo Generator, 3 phase, 60 cycles, 6600 volts, 3600 R.P.M., 4—stage, 0# — 15# ga. extraction type, 225#, 100° F. superheat, 28" maximum vacuum, 128,000# per hour extraction maximum at full load. Can be operated either condensing or non-condensing.

1—1600 K.W. General Electric Co. Turbo Generator, 3 phase, 60 cycles, 6600 volts, 3600 R.P.M., Form E, Curtis Condensing turbine, 230#. Can be operated either condensing or non-condensing.

Power House Equipment consisting of:
1—20-panel Switchboard.
1—50 KW Turbine driven Exciter.
1—100 KW G.E. Motor driven Exciter.
Miscellaneous—Overhead Crane, Electric yard Crane, Steam yard Crane, Gas Tractor.
1—Condensing Equipment for 3500 KW Turbo Generator consisting of—1 Allberger Spiroflow Surface Condenser, condensate pumps, circulating pump, 2 Allberger Occluders and 2-stage After Condenser.
1—Condensing Equipment for 1600 KW Turbo Generator consisting of 3 pass Allberger Surface Condenser, condensate pump, turbine and motor driven circulating pumps, steam driven Knowles air pump.

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from L. J. LAND & COMPANY, New York's Largest Stock of Electrical Equipment

A.C. EQUIPMENT

SYNCH. MOTORS

200 H.P. G.E. TS 514 RPM
90 H.P. Westinghouse 900 RPM
50 H.P. Elec. Mchy. 1200 RPM

SLIPRING MOTORS

300 H.P. General Electric 720 RPM
200 H.P. General Electric 514 RPM
150 H.P. Allis Chalmers 720 RPM
2—125 H.P. G.E. 720 RPM
112 H.P. G.E. hoist 720 RPM
100 H.P. Fairbanks Morse 720 RPM
100 H.P. Allis Chalmers 720 RPM
100 H.P. Westinghouse 720 RPM
75 H.P. Westinghouse 1200 RPM
75 H.P. Allis Chalmers 600 RPM
60 H.P. Westinghouse 1200 RPM
60 H.P. General Electric 1200 RPM
60 H.P. General Electric 900 RPM
6 H.P. Westinghouse 300 RPM
4 H.P. GE. MT 900 RPM

SQUIRREL CAGE MOTORS

200 H.P. Allis Chalmers 1800 RPM
200 H.P. Allis Chalmers 1200 RPM
200 H.P. General Electric 600 RPM
150 H.P. Westinghouse 1800 RPM
100 H.P. G.E. 1200 RPM
100 H.P. General Electric 900 RPM
75 H.P. Westinghouse 900 RPM

A.C. GENERATORS

200 K.W. General Electric 600 RPM
125 KVA G.E. 900 RPM
100 KVA Crocker Wheeler 900 RPM
100 KVA Elec. Machy. 1200 RPM
75 KVA G.E. 1200 RPM
15, 20, & 25 KVA 1200 RPM (8)

LOW & HIGH VOLT. GEN.

200 K.W. Wghse. 600 V. Mtr. Gen Set
800 amp. 10-50 Volts G.E.
2 to 40 K.W. 600 to 2000 V. M.G. Sets (11)
24 K.W. 60 V. General Electric
1 to 75 K.W. 10 to 80 V. (15)

100 KW Westinghouse Syn.
MOTOR GENERATOR SET
Motor: 150 H.P. 3 ph. 60 c. 440 V 1200 RPM
Gen. 100 KW 250 Volt 1200 RPM—Complete
AC & DC Control Equipment

ANODIC TREATING GENERATORS
3—1600 Amp. General Electric, Syn. 3 unit Motor Generator Sets, 10 to 50 Volts—complete.

4—48 CFM. Ingersoll Rand 125-lb. V Belt driven. New——immediate delivery.

In Stock for Immediate delivery
Motor Driven Electric ARC Welders—Portable and Stationary—150 Amp. to 600 Amp.

MISCELLANEOUS

12½ x 12, 390' Amer. Air Comp.
14 x 10 Ingersoll Rand Air Comp.
1 Ton Shepard
15 to 50 K.W. Frequency Changers 90, 100, 120 cycle (7)
5 H.P. B & D D.C. Buffer Fans & Blowers (19)
Tirrell Voltage Regulators
6—200 KVA G.E. Transformers 13200/2300/4000
165 KVA Arc Furnace Transformers

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D.C. EQUIPMENT

230 V. D.C. MOTOR GEN. SETS

100 K.W. West. 1200 RPM
75 K.W. Elect. Machy. 1200 RPM
50 K.W. Burke 1200 RPM
45 K.W. Westinghouse 700 RPM

125 V. M.G. SETS

2—100 K.W. Westingh. Syn. Motor
60 K.W. Westinghouse Syn. mtr.
50 K.W. Crocker Wheeler
40 K.W. Westinghouse
35 K.W. Elec. Machy. Syn.
25 K.W. Gen. Elec.

230 V. D.C. MOTORS

75 H.P. General Electric 850 RPM
60 H.P. Sprague 900 RPM
60 H.P. G.E. 1000 RPM
60 H.P. Roth 600 RPM
50 H.P. G.E. 850 RPM
40 H.P. Reliance 625 RPM

330 V. VAR. SPEED MTR.

100 H.P. Crock. Wh. 550/900 RPM
75 H.P. Electro Dyn. 700/1050 RPM
75 H.P. G.E. 1000/1500 RPM
50 H.P. Gen. Elec. 500/1500 RPM
30 H.P. G.E. 825/2000 RPM
25 H.P. G.E. CD 600/1200 RPM
15 H.P. G.E. RF 400/1200 RPM
15 H.P. West. .825/1650 RPM
15 H.P. G.E. 600/1800 RPM
15 H.P. Electro Dyn. 450/1350 RPM

115 VOLT D.C. MOTORS

90 H.P. General Electric 900 RPM
30 H.P. Star B.B. 1800 RPM
15 H.P. Eck 1500/1800 RPM

SUCCESSFUL OPERATION GUARANTEED

Every Machine in This Ad is Owned Outright By Us

D C MOTORS

230 Volt—Constant Speed

	HP	Make	Type	Speed
1—	300	Cr. Wh.	CCM-108H	550
1—	250	Al. Ch.		525
2—	200	Whse.	SK	400
1—	200	G.E.	DMC	475
1—	150	G.E.	MPC	275
1—	140	G.E.	MDS-108	410
1—	125	G.E.	CDP-123	1750
1—	100	G.E.	CD-123	1150
1—	75	Cr.Wh.	CMC-65H	600
1—	45	Cr.Wh.	65H	400
1—	30	Whse.	SK	850

230 Volt—Adjustable Speed

1—	600	Whse.		150/275
1—	500	G.E.	MPC	675/900
1—	300	G.E.	MPC	250/400
1—	300	G.E.	MPC	275/550
2—	275	G.E.	DMC	500/750
1—	200	Whse.		400/500
1—	150	G.E.	MPC	250/450
2—	100	G.E.	CD-123	1150/1450
1—	100	AlCh.		950/1150
1—	75	Cr.Wh.	65H	600/1200
1—	75	G.E.	C	500/1000
2—	60	El.Dy.	S	525/1050
4—	50	Cr.Wh.	CMC-81H	300/900
1—	50	Whse.	SK	350/1050
1—	50	Rel.	461T	500/1500
1—	30	Whse.	SK	575/1150
1—	25	Cr.Wh.	50H	335/1000

TRANSFORMERS

	KVA	Make	Ph.	Type	Voltages
1—	1250	Whse.	3	Auto	4000x2300
4—	1000	G.E.	1	HKDD	13800x2300
3—	333	Pitts.	1	OISC	13800x440/220
3—	300	G.E.	1	H	132200x2300/575
2—	200	Whse.	1	SK	6900x230/460
3—	200	G.E.	1	HKDD	13800x575
3—	100	Whse.	1	OISC	13200x250

ENGINE GENERATOR SET

1—100 KW, Whse. D.C. Gen. 125/250 v. 3 wire 250 R.P.M. dir. Conn. 150 H.P., 14x15 Skinner steam engine 150# press

MOTOR GENERATOR SETS

3 phase—60 cycles

2—1500 KW G.E. 600 v. Gen d.c. to 2100 HP 6600 v. syn. motor
1—500 KW G.E. 600 v. Gen. d.c. to 700 HP 13200 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 2300 v. syn. motor
1—300 KW G.E. 600 v. Gen d.c. to 435 HP 10000 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 350 HP 4600 v. syn. motor
1—200 KW Ridg. 275 v. Gen d.c. to 300 HP 2300 v. syn. motor
1—200 KW Al. Ch. 3 units; 2—100 KW 250 v., Gen. d.c. to 220 KVA 2200 v. syn. motor.
1—150 KW Ridg. 275 v. Gen d.c. to 250 HP 2300 v. syn. motor
1—125 KW G.E. 250 v. Gen d.c. to 190 HP 2200 v. syn. motor.
1—100 KW Whse. 125 v. Gen d.c. to 150 HP 440 v. sq. ck.

MOTOR GENERATOR SETS

3 phase—25 cycle

1—2000 KW Al. Ch. 250 v. Gen d.c. to 2800 HP 6600 v. syn. motor
1—300 KW G.E. 600 v. Gen d.c. to 435 HP 2300 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 390 HP 6600 v. syn. motor

TURBO GENERATOR SET

1—500 KW, Whse., 625 KVA, 480 v., 3 ph., 60 cy. generator with Curtis single stage 160/125 pound non-condensing turbine good for 5 to 10 pounds back pressure
1—500 KW, G.E., 625 KVA, 2300 v., 3 ph., 60 cy. generator with Curtis 4 stage, 150 pound condensing turbine complete with condenser, etc.

ROTARY CONVERTERS

1—500 KW, Westinghouse, 900 RPM, 125/250 volt, DC, with 3- single phase, 60 cycle, 13200/6600/2300 volt transformers and panels
1—500 KW, G.E., type HCC, 1200 RPM., D.C., 600, V, AC, 6 ph, 60 Cy., 1200 RPM.

A C MOTORS

3 phase—60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	2150	G.E.	ATI	2200	360
1—	2000	G.E.	ATI	2300	450
1—	350	Cr.Wh.	301	2200	600
1—	300	G.E.	ATI	440	600
1—	300	G.E.	ATI	2300	600
1—	200	Whse.		440	514
3—	150	G.E.	TRB	220x440	450
1—	150	Whse.		2200/550	1800
1—	100	Whse.		2200/550	1800
1—	100	Whse.	HP	220	300
1—	100	Whse.	G	2300	900

Slip Ring

1—	1000	G.E.	IM	2200	720
1—	800	Whse.	Mill	2200	250
1—	600	Whse.	CW	2200	870
1—	450	Whse.	CW	2200	875
1—	450	G.E.	MTP	2200	1200
1—	400	G.E.	MT	550/440	300
1—	400	Al.Ch.		2300	505
1—	300	Al.Ch.	ANY	2200	585
1—	200	Whse.	CW	2300	1170
2—	300	G.E.	IM	2300	585
1—	250	G.E.	MT	4000/2300	257
1—	250	F.M.	BV	2200	1200
2—	200	Whse.	CW	2200	514
2—	150	G.E.	IM	2200	695
1—	100	G.E.	IM	550	720

Squirrel Cage

1—	500	G.E.	1-17B	2200	690
1—	400	G.E.	KT	2300	585
1—	300	Whse.	CS	550	580
2—	300	G.E.	IK	2300	600
2—	300	G.E.	IK	440	600
1—	250	Al.Ch.		220/440	1150
1—	200	Whse.	CS	550	720
1—	150	G.E.	IK	2200/440	900
3—	150	Al.Ch.	AN	220/440	1750
3—	100	Whse.	CS	550	1800

RE-NU-BILT BELYEA MOTORS

What are your requirements? units up to 5000 kw available in stock.

BELYEA
COMPANY INC.

Main Office & Shop: **43 HOWELL ST., JERSEY CITY, N. J.**

TURBOS 60 Cycle

5,000 KW GE Curtis 60/3/2300/1800 RPM—175# Condenser

1—4000 KW GE 60/3/6600/1800 RPM—150#—Surface Condensers

2—3000 KW Wemco Parsons Single Flow Reac 60/3/4400/1200—Surface Conds.

2—3125 KVA Lynn Type GE Rigid Frame 60/3/2300/3600 RPM. Surface Condenser.

2500 KVA Wemco Imp & Reac 60/3/2300/3600 RPM. Surface Condenser. Rare short log service.

937 KVA GE Bleeder 60/3/2300/3600 RPM 200#. Condenser.

2—625 KVA Wemco 10-C Parsons or NC 60/3/440/2200/3600—Jet Condenser—Surface avail.

300 KW Wemco Single Wheel Re-entry 60/3/240—120/250#.

TURBOS 25 Cycle

6000 KW GE Curtis 25/3/6600/1500 RPM—Jet Condenser—Surface avail.

2—6000 Wemco Impulse & Reaction Semi-Double Flow—25/3/2300 & 13200—Surface Condenser

2—3500 KW Imp & Reac 25/3/13200—Surface Condenser.

2—1500 KW Wemco 25/3/2400/1500—Condensers.

MOTOR GENERATORS

1500 KW Type MPC 60/3/4000: 600 volts—360 RPM

Several 500's also available 250—600 volts

BOILERS

2—1,000 Hp. Edgemoor ASME identified 200# Box steel header straight Tube Water Tube Boilers, oil fired, practically brand new, one never operated; one operated few months only on experimental program.

9-600 HP B&W Vertical Steel Header Long. 3-drum 200# Superheater and Taylor Stokers.

3—500 HP Edgemoor Steel Header Boilers—200#—Foster Superheaters

1—389 HP B&W Stirling Water Tube ASME and Hartford—200#—Stokers and all auxiliaries

ROTARY CONVERTERS 60 Cycle

2—1000 KW Wemco 60/6/650 DC—900 RPM

ROTARY CONVERTERS 25 Cycle

3500 KW GE Syn Booster 3/6 ph—250 DC—167 RPM—Transformers 11000: 196 volts.

1—2000 Wemco Shunt Wound Booster Type Syn 25/3/191: 270 DC—300 RPM Transformers 4000:191 volts

FREQUENCY CHANGERS: 2000 KVA, 62½ cy.; 1000, 3000 KW, 60 cy.
CONDENSERS-SURFACE:—25000 to 1000 sq. ft.
MOTOR GENERATORS: 60/25 cycles 1500 to 300 KW
MOTORS: 60 cycles 4000-1000 HP.
TRANSFORMERS: 60/25 cycles—15000 to 500 KW
TURBOS: 4000-300 KW 60 cycles—many choice units not listed.

Pressure activity and commitments of World War #2 have snapped up 80% stock on hand. Recommend phone command to bind above available units.

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.

1—9375 KVA General Electric Cond.
1—7500 KVA General Electric Cond.
1—6250 KVA General Electric Cond.
1—3750 KVA Westinghouse Cond.
1—3125 KVA Allis Chalmers Cond.
1—3125 KVA General Electric 375# Cond.
1—2500 KVA General Electric Cond.
1—1563 KVA General Electric Cond.
1—1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA Terry Double Extr. Cond.
3— 625 KVA General Electric Cond.
1— 625 KVA General Electric Extr. Cond.
1— 375 KVA General Electric Cond.
1— 250 KVA General Electric Cond.
1— 938 KVA West. 375# I.P. 100# B.P. N.C.
1— 375 KVA General Electric Non-C.
1— 312 KVA Moore Non-Condensing
2— 156 KVA Allis Chalmers Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1—1000 KVA Skinner Uniflow
2— 937 KVA Nordberg Uniflow
1— 500 KVA Rice & Sargent Corliss
1— 425 KVA Hamilton Poppet Valve
1— 325 KVA Skinner Uniflow
1— 250 KVA Skinner Uniflow
1— 250 KVA Harrisburg Uniflow
1— 240 KVA Hamilton Corliss

DC STEAM ENGINE UNITS

1—500 KW Skinner Uniflow 250 V.
1—400 KW Mesta Uniflow 250 V.
1—300 KW Skinner Uniflow 250 V.
1—300 KW Chuse 4-valve 250 V.
2—250 KW Skinner Uniflow 250 V.
1—200 KW Chuse 4-valve 250 V.
2—150 KW Erie Ball 4-valve 250 V.
1—150 KW Ames Uniflow 125/250 V. vertical
1—125 KW Ames Uniflow 125/250 V. Vertical
1—100 KW Ames Uniflow 120 V.
1— 75 KW Skinner Uniflow 250 V.
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.

1—1750 KVA Mesta (gas) 2300 V.
2—1000 KVA Mesta (gas) 2300 V.
1—1000 KVA Nelseco Diesel 2300 V.
1— 603 KVA Fair.-Morse 480 V.
1— 375 KVA Cooper-Bess. 2300 V.
1— 375 KVA Ing.-Rand 2300/440/220 V.
1— 237 KVA Fair.-Morse 480 V.
1— 210 KVA Natl. Superior 440/220 V.
1— 200 KVA Fair.-Morse 2400/440/220 V.
1— 100 KVA Buckeye 240/480 V.

WATER TUBE BOILERS

5—525 HP Springfield 200-lb. Stokers
2—520 HP Heine 200-lb. Hand Fired
1—512 HP Erie City 175-lb. Oil Burner
2—511 HP Union 200-lb. Stokers
1—500 HP B. & W. 200-lb. Stoker
1—468 HP Keeler type C-P 250-lb.
2—417 HP Erie City 250-lb. Stokers
2—389 HP Stirling 200-lb. Stokers
1—375 HP B. & W. 200-lb. Stoker
2—357 HP Casey-Hedges 175-lb. Stokers
1—353 HP Edge Moor 200-lb.
1—325 HP Stirling 160-lb. Stoker
2—282 HP Edge Moor 200-lb. Stokers
2—254 HP Stirling 180-lb. Stokers
2—160 HP Stirling 155-lb. Hand Fired.

SYNCHRONOUS CONDENSERS

1—4000 KVA G. E. 13200 V. 514 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1—1000 KVA G. E. 2300 V. 900 RPM
1— 500 KVA West. 2200 V. 900 RPM

SYNCHRONOUS MOTORS—60 Cy.

1—500 HP General Electric 440 V. 360 RPM
1—225 HP General Electric 2200 V. 225 RPM
2—200 HP General Electric 440 V. 277 RPM
1—175 HP General Electric 440 V. 277 RPM
1—100 HP General Electric 440 V. 277 RPM

OIL CIRCUIT BREAKERS

1—800 A. 87 KV Am.Br.Bov. AF22 Outdr.
2—600 A. 37 KV Condit FO40-37 Outdoor
5—600 A. 30 KV Kelman CB-76 Outdoor
1—400 A. 25 KV G. E. FK0136 Outdoor

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA West. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1250 KVA G. E. 25/62½ cy. 375 RPM
1—1000 KVA G. E. 60/25 cy. 514 RPM
2— 750 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA G. E. 25/60 cy. 300 RPM

ROTARY CONVERTERS—60 Cy.

2—1000 KW General Electric, 600 V.
1— 750 KW General Electric, 250 V.
1— 500 KW General Electric, 250 V.
1— 500 KW General Electric, 600 V.
2— 300 KW General Electric, 600 V.

TRANSFORMERS—1 Ph. 60 Cy.

3— 600 KVA West. 120,000/2300 V.
3— 1667 KVA G. E. 66000/22000 V.
1— 1500 KVA Pitts. 66000/33000 V. 3 ph.
2— 1000 KVA West. 66000/2300 V.
3— 750 KVA Pitts. 66000-22000/33000 V.
3— 333 KVA Pitts. 44000/2300 V.
3— 500 KVA Allis 33000/480 V.
2— 1000 KVA G. E. 23000-11500/575 V.
3— 100 KVA G. E. 22000/6900 V.
2—10000 KVA Pitts. 13200/4600 V. 3 ph.
5— 1000 KVA G. E. 13800/2300 V.
1— 450 KVA G. E. 13200/240-480 V. 3 ph.
4— 200 KVA West. 13200/230-4000 V.
3— 150 KVA Pitts. 13800/230-460 V.
3— 75 KVA West. 13800/230-460 V.
3— 150 KVA Pitts. 11000/2400 V.
3— 100 KVA West. 11000/250-125 V.
3— 75 KVA G. E. 11000/9900/244-488 V.
2— 3300 KVA G. E. 6600/110 V. 3 ph. Furnace
3— 100 KVA G. E. 6900/440-220 V.
3— 833 KVA Penn. 4800/120-240 V.
3— 1500 KVA West. 2300/106 V. 3 ph. Furnace
3— 1000 KVA Pitts. 2300-4600/550 V.
3— 75 KVA Wagner 2300/230-460 V.
6— 50 KVA G. E. 2400/240-120 V.
6— 50 KVA G. E. 2400/240-120 V.
3— 50 KVA Wagner 2400/480-240 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY

MOTORS • GENERATORS • TRANSFORMERS

Prices on application

3 PHASE—60 CYCLE 220/400 VOLT

H.P.	Make	RPM	Type	Frame
15	Allis-Chalm.	1750	2K54411	
20	Gen. Elec.	1750	KT	753
20	Gen. Elec.	600	I	K
25	Burke	900	EM	
40	Gen. Elec.	900	KT	336
40	Burke	1200	EM	45
40	Westing.	1750	CS	
50	Westing.	900	CS	
50	Gen. Elec.	900	KT	542
60	Burke	900	EM	7
60	Gen. Elec.	1200	I	K
60	Gen. Elec.	1800	I	K
75	Gen. Elec.	1200	KT	343
5) 75	Gen. Elec.	1200	I	K
75	Gen. Elec.	1800	I	K
75	Gen. Elec.	900	I	K
100	Burke	720	EM	10
100	Gen. Elec.	1750	I	K
100	Westing.	900	CS	
100	Lincoln	1200		
150	Gen. Elec.	1200	I	
150	Westing.	900	CS	
200	Gen. Elec.	600	I	K
200	Gen. Elec.	720	I	K
200	Gen. Elec.	900	I	K
200	Gen. Elec.	1200	I	K
250	Gen. Elec.	600	I	K
250	Gen. Elec.	720	I	K
250	Allis-Chalm.	900		
300	Gen. Elec.	720	I	K

Compensators in stock up to 300 H.P.

AIR COMPRESSERS

1—14"x9"x12" Imperial-Type Ingersoll-Rand two stage 100 lb. pressure belt drive.
1—16"x10"x14" Imperial-Type Ingersoll-Rand two stage 100 lb. pressure belt drive.

BARGAIN

30—3 HP. General Electric Motors. 3/60/220/3600 rpm. $37.00 each.

100 K.V.A. GENERATOR For Diesel Use

1—100 KVA Crocker Wheeler 3/220/60 cy. 257 RPM. For direct connection to Diesel. 2 Bearing Machine with exciter and panels.

ANODIZING M. G. SET

1—1000 Amp. 60 Volt General Electric Generator, Type CD-115Y, 1200 RPM, direct connected to 90 H.P. General Electric Synchronous Motor, 3 phase, 60 cycle, 440 volt, 1200 RPM; 3-bearing Factory built machine, complete.

SPECIAL MOTORS

1100 H.P. General Electric Synchronous Motor, 3 ph., 25 cy., 11,500/6600/2200 V., 375 RPM.
1—500 H.P. Gen. Elect. Sync. 3/2200/60/1200 R.P.M. with Exciter. New.
500 H.P. Allis-Chalmers, 3 ph., 25 cy., 440 V., 490 R.P.M., Complete.
300 H.P. G.E. Slipring, 25 cy., 3 ph., 2200 V., 500 RPM, 3 bearing; complete with controls.
225 H.P. Electric Mchy. Co. Synchronous, 3 ph., 25 cy., 2200 V., 500 R.P.M. with controls.
2—100 H.P. G.E. Synch. Motors, 3 ph., 25 cy., 220/440 V., with control equipment.

FREQUENCY CHANGERS

1—600 KW Gen. Elec. Syn. 2300 V., 25 cy. to 2300 V. 60 cy.
1—565 KVA Westinghouse Synch. 2200 V. 25 cy. to 220 V. 3 Ph, 60 cy.
2—400 KW General Electric Synch. 6600 V., 25 cycle to 440/2300 V. 60 cy.

TRANSFORMERS

Amt.	KVA	Make	Cycle	Voltage
3	40	Gen. Elec.	25	2200/440
3	50	Gen. Elec.	60	2200/220/440
2	75	West.	60	2200/120/240
3	100	Gen. Elec.	60	24/120/240
2	100	Gen. Elec.	60	4600/115/230
3	200	Gen. Elec.	25	13,200/240/480
3	333	Gen. Elec.	60	6900/230/460
3	500	Gen. Elec.	60	2200/220/440
3	500	Pittsburgh	25	11,500/100
3	833	Gen. Elec.	60	13,800/460
3	1000	Pittsburgh	60	2300/4600/115
3	1000	KVA.Wagner	60	33000/2300

All Sizes and Voltages Available.

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

H.P.	Make	Type	Frame	RPM
300	Gen. Elec.	I	Form M	1185
75	Gen. Elec.	MT	537	1800
60	Gen. Elec.	MT	353	1800
60	Gen. Elec.(2)	MT	353	720
50	West.	CW	654C	1800
50	West.	CW	644C	900
50	West.	CW	654C	1800
40	Wagner	22WB		540
40	West.	CW	748	690
40	West.	CW	748	690
40	West.	CW	748	690
30	West.	HF	8B	1745
30	Gen. Elec.	MTC		1725
25	Gen. Elec.	MT	513	1800
25	Gen. Elec.	I	M	1200
25	West.	CW	750C	575
20	West.	CW	648A	575
20	West.	CW	644C	575
20	Gen. Elec.	MT	332	545
20	West.	CW	748A	575
20	West.	CW	748A	575
20	West.	CW	748A	575
15	Gen. Elec.	I-M		1725
15	Gen. Elec.	ITC		1725
10	Gen. Elec.	MT		1725

25 CYCLE, 3 PHASE, 440 VOLTS

H.P.	Make	Type	Serial	RPM
150	Gen. Elec.	MT563Y	5056230	725
125	Gen. Elec.	I-17	4550934	360
50	Gen. Elec.	MT547	5264084	720
50	Gen. Elec.	MT353	3879210	750
50	Allis-Chal.		7923K	715
52	Gen. Elec.	ITC5013	1773223	700
40	Gen. Elec.	MT543	4817983	750
40	Gen. Elec.	MT343	3887755	750

GENERATOR & EXCITER

1—62½ KVA 3 ph. 60 cy. 240 v. 1200 rpm Allis-Chalmers generator, serial No. 113797, with exciter, direct Connected stock No. E11317. Comp. with Base Pulley and Panel.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

Immediate Shipment!

2—200 KW **Westg. Syn. Motor Generator Sets,** 600 V. D.C., Gen., connected to 290 H.P. Synch. motor 3/60/2200 and 900 RPM, with exciters and controls
1—1000 KW **Turbine type Generator,** 3/60/2300 3600 RPM, Type ATB 2
1—25 KW **Westg. Turbine and Generator,** 125 V. D.C., 3500 RPM
5—50 H.P. **G.E. Unused Slip Ring Type MTC Hoist and Crane Motors,** 600 RPM, 3/60/440.
8—50 H.P. NEW **Allen-Bradley Reversing Type Controllers,** self-contained, 3/60/440 V.
1—100 H.P. **Allis Chalmers Induction Motor** 1750 RPM, 3/60/2200
4—50 H.P. & 100 H.P. **Electric Solenoid Brakes,** 3/60/440
1—700 GPM, 200' hd. electric motor driven **Manistee Water Pump,** 3/60/2200.

IRON & STEEL PRODUCTS, INC.

13488 So. Brainard Ave., Chicago, Illinois

"Anything containing IRON or STEEL"

"BEHRS" GUARANTEED REBUILT EQUIPMENT

3000 **Electric Motors,** 1 H.P. to 200 H.P.
Blowers—all types and sizes

SPECIAL
2000'—2 Pd. G.E. **Positive Pressure Blower** M.D. 27 H.P. 3 ph. 60 cy. 220/440

Boilers—High and Low Pressure
Compressors—5 to 500 cu. ft.
Pumps—steam and electric
Metal and Woodworking Machinery.

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JOS. BEHR & SONS, Inc.

Machinery & Industrial Equipment

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MOTORS
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OIL SWITCHES
AIR CIRCUIT BREAKERS

ELECTRIC EQUIPMENT CO.
347 N. Clinton Ave., Rochester, N.Y. Tel: Main 252

BOILERS

1—783 h-p Water Tube Boiler
1—1014 h-p Water Tube Boiler
2—511 h-p Water Tuber Boilers,—complete Plant
2—78"x18" H-R-T Boiler Plants—and Stoker

F. MAYER

608 S. Dearborn St. CHICAGO, ILL.

Available for Immediate Delivery

FREQUENCY CHANGERS

4—**1000 KW FREQUENCY CHANGERS:** —1000 or 1500 HP Westinghouse MOTORS, 4000 volt, 3 phase, 60 cycle, 500 RPM direct connected to 2200 volt GENERATORS, 1000 KW single phase, 25 cycle, 500 RPM. Also three EXCITER SETS, 50 KW, 125 volt, 690 RPM, driven by 75 HP Westinghouse MOTOR, 400 volt, 3 phase, 60 cycle, 690 RPM.

for Better Used Equipment

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DULIEN STEEL PRODUCTS, Inc.

414 First Ave. So. Seattle, Wash.

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DIESEL ELECTRIC PLANT

With Auxiliary Equipment—Ready to Operate

1120 H.P. IN TWO FAIRBANKS-MORSE UNITS FULL DIESEL—MODEL 33 STYLE M. DIRECT CONNECTED TO TWO GENERATORS 384 KW—470 KVA EACH, 2400 OR 600 VOLTS 3 PH. 60 CY.

Pedro J. Smith, Inc. **100 East 42nd St., New York City**

ENGINE GENERATOR SET

300 KW Nordberg Unaflow Engine Generator Set. 230/115 Volts D.C. On Original Foundation Complete. Purchased new in 1924 A-1 Condition.

Paul Jay Electrical Machy. Corp.
672 Bergen St. Brooklyn, N. Y.

DIESEL ENGINES

150 HP Fairbanks Morse Diesel
70 HP F-M Marine Dir. Reversing
60 HP F-M Cold Start Diesel
25 HP Worthington Full Diesel
32 KVA Gen. D/C F-M Full Diesel

All these Engines, equal to new.

H. & P. MACHINERY CO.
Diesel Engine Experts
5819 ENRIGHT AVE. ST. LOUIS, MO.

REBUILT POWER EQUIPMENT—Ready to Ship

A.C. and D.C. MOTORS—1 H.P. to 1,000 H.P.

MOTOR GENERATOR SETS
3 ph. 60 cy.—Synchronous

1—100 kw. Westg. 250 v. DC 2300/3/60 Syn.

ENGINE GENERATOR SETS

175 kw. G.E. 2200/3/60 dir. con. Ridgway Engine.
300 kw. West. 250 v. DC dir. con. Skinner Automatic Uniflow.

ROTARY CONVERTER

2—150 kw. West. 250 v. 1200 rpm. 2300/4000 AC.
100 kw. G.E. Synchronous 275 V. 1200 rpm. 2300/4000 transformers.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)
125 kva. West. 2300/3/60 900 rpm.
75 kw. G.E. 240/3/60 900 rpm. 80% P.F.

SPECIALS IN SLIPRING MOTORS
3ph. 60 cy.

HP	Make	Speed	Type
700	G.E.	393	MT-432
400	West.	1170	CW
260	Burke.	600	EM-65
250	G.E.	590	I-174
200	West.	690	CW-956A
100	West.	1750	CI

SYNCHRONOUS MOTOR

225 HP. G.E. 2200 v. 3 ph. 60 cy. 80% P.F. (Can reconnect 440 or 220 v.)

A.C. MOTORS—3 ph. 60 cy.

HP	Volts	Make	Type	Speed
150	220/440	West.	CS	1800
150	2300	West.	Syn.	900
200	2200/440/220	West.	CS	250
200	2200	G.E.	IK-15	1200
200	220/440	West.	CS	1200
200	220/440	West.	CS	720
200	220/440	West.	CS	600
225	2200	West.	CS	900
250	220/440	West.	CS	900
250	2200	West.	CS	1200
300	220/440	West.	CS	1150
300	2300	West.	CS	1200
300	2200/440/220	West.	CS	450
350	2200/440/220	West.	CS	450
400	2200/440/220	West.	CS	500
450	2200/440/220	West.	CS	600
500	2200/440/220	West.	CS	720
600	2200/440/220	West.	CS	900

230 V. VARIABLE SPEED MOTORS

HP	Make	Type	Speed
25	West.	SK	825/1625
20	West.	SK-133	575/1150
15	Louis Allis	NA	1150/1750
15	West.	SK-100L	600/1200
10	G.E.	LC	625/1250
10	Reliance	TF-78	500/1500

GAS ENGINE GENERATOR SET

75 kw. West. 250 v. belted to 110 HP 2 cyl. Bessemer Gas Engine.

SPEED REDUCERS

14—3 HP. 400 Ah. Cleveland ratio 60:1.
23—3 to 5 HP. Thomas 2 speed ratio 1 side 100 to 1 other side 5 to 1.
5—10 HP. 600 At Cleveland ratio 90:1.
1—150 HP. R.D. Nuttal ratio 1.6:1.

AIR COMPRESSORS

2— 15 cfm G.E. 90# pres. 2300 D.C.
1— 50 cfm Sullivan 1 cyl. horiz. 100# pres. 6x6
1—60 cfm. Kellogg complete with motor and tank.
1—485 cfm Ingersoll-Rand 14-10 single cyl. horiz. 60#.

SERIES WOUND MOTORS—230 V. D.C.

1—5 HP. G.E. CO-3, 725 rpm.
1—10 HP. G.E. CO-7½, 6500 rpm.
2—25 HP. Milwaukee 400 rpm.
1—50 HP. G.E. MDS106, 600 rpm.
3—50 HP. West. 38B, 500 rpm.

TRANSFORMERS—1 ph. 60 cy.

1—100 kva. West. 2200-220/110.
2—75 kva. Burke 2200-110 v. 3 ph.
1—50 kva. Burke 2200-110 v. 3 ph.
3—37½ kva. West. 22000-2200.
2—25 kva. G.E. 2300-220/440.
6— 10 kva. Pgh. 2200-220/110.

TURBINE

1—Kerr Economy Steam Turbine 450 B.H.P. 3800 rpm. 5" intake, 12" exhaust with Kerr Reduction Unit 3800 to 720 rpm. 115 lbs. pres.

AC STEAM ENGINE GENERATOR SETS

225 kw. Elec. Machy. 2300/3/60 dir. con. Ideal Engine 4 valve non releasing 18x22.
175 kw. Westg. 2200/3/60 dir. con. Skinner Engine 18" x 16".

DIESEL ENGINE GENERATOR SETS

200 kva. Fairbanks Morse 2400/3/60 dir. con. F.M. Diesel Engine 4 cyl.
100 kva. Fairbanks Morse 2400/3/60 belted to 2 cyl. F.M.

DUQUESNE ELECTRIC & MFG. CO., Pittsburgh, Pa.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt Street
New York, N. Y.

AC TURBINE UNITS

5000 KVA G. E. Condensing 500° TT.; 6000/4000 v.; cond.
2500 KVA Wghse. 2300 v., 500° TT.; Cond.
1875 KVA Ridgeway 2300 v., 500° TT.; Cond.
1250 KVA G. E. 2300/4000 v., 600° TT.; Cond.
937 KVA Al. Chal. 2300 v., 550° TT.; Cond.
937 KVA G. E. 2300 V., 500° TT.; Cond.
937 KVA Al. Chal.-Elliot 480 V., 500° TT· Cond.
937 KVA G. E. 2300 V. Automatic Extraction, 500° TT.; Cond.
780 KVA Al. Chal.-Terry 600 V., Automatic Extraction, 500° TT.; Cond.
780 KVA Wghse. 2400 V., 500° TT.; Cond.
625 KVA G. E. 2300 V., 500° TT.; Cond.
625 KVA Al. Chal.-Elliot 440/220 V., Automatic Extraction, 500° TT.
625 KVA Wghse. 2300 V., 500° TT., *Non-Cond.*
375 KVA G. E. 2300 V., 500° TT.; with Cond.
375 KVA G. E. 2300 V., 500° TT.; *Non-Cond.*
312 KVA Ridgeway-Elliot, 480 V., 500° TT. Cond.
150 KVA Wghse. 240/480 V., 500° TT.; Cond.
125 KVA Wghse. 240/480 V., 500° TT.; *Non-Cond.*; 25 to 60 lbs. b.p.

DIRECT CURRENT UNITS

KW	GEN.	VOLTS	ENGINE
1000	Al. Chal.	250	Al. Chal.
600	G. E.	250	Corliss
300	G. E.	250	Skinner Unif.
300	Wghse.	250	Murray Corliss
200	Wghse.	250	Turbine
200	G. E.	125	Erie Ball 4 V.
150	G. E.	250	Skinner Unif.
100	C. W.	250	Erie Ball 4 V.
100	G. E.	125	Erie Ball 4V.

A.C. UNITS

450 KVA Wghse.—18x36 Filer Stowell Corliss
375 KVA G.E.—22x27 Erie Ball 4 V.
312 KVA G.E.—20x30 Fitchburg 4 V.
312 KVA Elec. Machy—20x24 Chuse Uniflow
312 KVA Wghse.—21x22 Skinner Uniflow
300 KVA G.E.—18x36 Murray Corliss
300 KVA G.E.—Murray Uniflow
250 KVA G.E.—18x42 Hewes-Phillips Corliss
250 KVA G.E.—17x20 Erie Ball, 4 V.
200 KVA G.E.—21x22 Skinner Uniflow
200 KVA Al. Chal.—14x36 Al. Chal. Corliss
112 KVA G.E.—14x18 Erie Ball 4 V.
100 KVA G.E.—14x16 Skinner Uniflow
60 KVA G.E.—12x12 Skinner Uniflow

BOILERS (ASME)

728 HP E.C. Vert. 200#
600 HP (4) B & W 200#
508 HP (2) B & W 200#
502 HP (2) Edgemoor (Heine) 225# "Nation-Board." Practically new.
500 HP Murray (Heine) 200#
484 HP Springfield Cross drum, 200#
398 HP (3) Marine type, cross drum, 200#
389 HP Sterling 200#. "National Board".
340 HP (2) Brunswick Kroeschell, cross drum, box header. 165# "National Board." With Detroit Underfeed stokers.
300 HP (2) B & W 160#
300 HP Heine 175#
253 HP Cumbustion Engr. Co. 165#. "National Board"; practically new with Detroit Roto-stoker
200 HP Combustion Engr.; HRT 150#

PUMPS (Motor Driven)

17250 GPM Alberger 40' head
4000 GPM DeLaval 195' head
2000 GPM Worthington 290' head
1600 GPM Al. Chal. 216' head
1500 GPM DeLaval 290' head
1000 GPM Morris 255' head
850 GPM Al. Chal. 243' head
600 GPM Al. Chal. 450' head

ROTARYS

1500 KW Wghse. 600 V.—3 ph., 60 cy.
1000 KW G.E. 600 V.—3 ph., 60 cy.
500 KW G.E. 600 V.—3 ph., 60 cy.
400 KW (2) G.E. 250 V.—3 ph., 60 cy.
300 KW G.E. 600 V.—3 ph., 60 cy.
100 KW G.E. 275 V.—3 ph., 60 cy.

FREQUENCY CHANGERS

625 KVA Wghse. 60—25 cycles
625 KVA G.E. 25—60 cycles

TRANSFORMERS

2—687 KVA Maloney 2200/220 V.
2—500 KVA Maloney 13,800/480 V.
3—100 KVA Al. Chal. 22,000/440 V.
3— 75 KVA Wghse. 2300/575 V.

STEAM LOCOMOTIVE

American, 70 tons with tender Standard G

COMPRESSORS

1300 CFM Ingersoll-Rand 100 lbs, with 200 HP G.E., 3-60-440 V. motor
1000 CFM Ingersoll-Rand 3 lbs, with 100 HP A.C. motor

SURFACE CONDENSORS

3100 Sq. Ft Wheeler
2000 Sq. Ft. Wheeler
1200 Sq. Ft. Worthington

HEATERS

All sizes and types

ENGINES (belted)

TWIN ENGINE: 22x36 Nordbery Uniflow
20x21 Skinner Uniflow (15-20 lbs. b.p.)
16x16 Ames Uniflow

GAS & DIESEL UNITS

1000 KVA Al. Chal. 3 ph., 60 cy., with Worthington nat. gas engine
1000 KVA G.E. 3 ph., 60 cy., with Cooper Bessemer nat. gas engine
168 KVA Ideal 3 ph., 60 cy., with Fulton 3 cyl. Diesel Engine; dir. con. exciter
50 KW G.E. 125 V., with Muncie Diesel Engine

PROMPT SHIPMENT FROM OUR WAREHOUSE

750 KW TURBINE
Westinghouse Mixed Pressure 110# H. P. 2 to 4" L. P. 3600 RPM with gear box to 900 RPM with accessories. (Formerly connected to 750 KW 250 v. 900 RPM Gen.

M-G SETS 3 ph. 60 cy. (Syn.)
3—150 KW G.E. 500 v. DC—2200 v. AC 1200 RPM .8 P.F. ATI
150 KW Ridg. 275 v. DC—2200 v. AC 900 RPM
150 KW West. 550 v. DC—2200 v. AC—1200 RPM
2—100 KW G.E. 275 v. Type MPC cp. wd. interpoles dir. con. to 150 HP G.E. 70% Leading P.F. Type ATI 2330 v. 3 ph. 1200 RPM Syn. Motors. With or without switchboard panels.
90 KW Allis 250 v. DC—2200 v. AC 900 RPM
75 KW Westgh. 250 v. DC—2200 v. AC 900 RPM

ENGINE GENERATOR SETS
100 KW 250 v. DC. Westgh.—Skinner Engine

SYN. MOTORS 3 ph. 60 cy.

HP	Make	Volts	Speed
350	A.C.	2200	600
225	Ideal (Unity P.F.)	440	900
1-175	Westgh. .8 P. F.	2200	600
2- 75	G.E.	2200	900
75	Westgh.	220	1800

SLIP RING & SQ. CG. MOTORS (3 ph. 60 cy.)

HP	Make	Speed	Wdg.	Type
700	G.E.	393	S.R.	MT432
400	West.	500	S.C.	CS
200	West.	580	S.R.	CW
200	Cr. Wh.	440	S.R.	28
200	G.E.	700	S.R.	I M
200	Al. Ch.	600	S.C.	
150	West.	720	S.C.	CS
125	Al. Ch.	435	S.R.	
100	Lincoln	1200 RPM	S.C.	
100	F. M.	600	S.C.	BB
75	G.E.	690	S.R.	I M
75	West.	900	S.R.	CW752C
75	West.	575	S.R.	CW868A

DC VARIABLE MOTORS (230 VOLTS)

HP	Type	Make	Speed
75	SK	Westgh.	475/1425
20	SK	Westgh.	900/1800
10	SK	Westgh.	600/1200
5	SK	Westgh.	450/1800
2	SK	Westgh.	500/1800

300 HP D.C. VARIABLE SPEED MOTOR
Westgh. 230 v. 250/500 RPM interpole #8099644

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219 KVA G.E. TRE 2400/480/240 v. 3 ph. 60 cy. 200 RPM with exc.

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550 cu. ft. 100# Bury 2 stage
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50 HP Diamond 2 drums same shaft
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HP	Volts	Make	Speed
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300	2300–4000	G.E.	1200
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–440	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	2200–440	Whse.	1800
150	550–2200	G.E.	1800
100	500–2200	G.E.	720
100	220–440	G.E.	720
100	440–220	G.E.	600
100	220–440	G.E.	900
80	220–440	G.E.-MTC	900
75	440–220	G.E.	900
75	220–440	G.E.	600
60	220–440	G.E.	720

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400	440–220	Whse.	276
350	440–220	G.E.	200
250	2300	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
100	440–220	G.E.	1200
50	220–440	G.E.	1200

TRANSFORMERS—60 CYCLE

3—400 kva., G.E. type H, 13200-440.
3—250 kva., G.E. type H-KD 23000-2300.
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3—37½ kva., G.E., type H-K, 2300-230/115
3— 25 kva., G.E., type H-K 2300-230/460
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1—225 kva., 600 r.p.m., 2200-240-480 V., G.E.
1—219 KVA, 200 r.p.m., 480 V. Whse.
1—187 kva., 900 r.p.m., 2200-550-V., Westghse.

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HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200	Whse.	C.S.	1800
300	2300/440	G.E.	IE-K	1200
250	2200	G.E.	IE-K	1800
250	2200	G.E.	I-K	600
200	220/440	G.E.	IK	720
150	2200	Allis Ch.	AN	450
100	220/440	G.E.	KT	1200
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	1200
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E	K	1800

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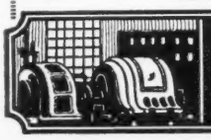

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1— 167 H.P. HRT—150#
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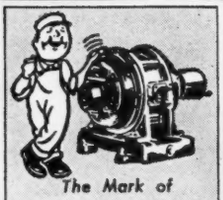

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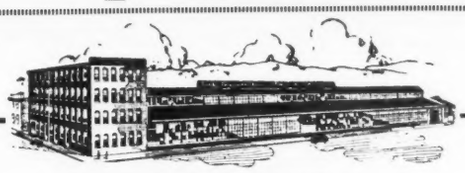

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945 HARRIET ST. Phone MA. 3024 CINCINNATI, OHIO

Motor Generator Sets—Synchronous Motors, etc.

MOTOR GENERATOR SETS, 3 phase 60 cycle A.C.

100 KW West. Rotary 275 Volt D. C. 2300 Volt A.C.
75 KW West. M.G. Set 250 V. D.C. 440 V. A.C.
50 KW Allis-Chalmers 250 V. D.C. 2200 V. A.C.
15 KW Burke 125 Volt D.C. 220 Volt A.C.

SYNCHRONOUS MOTORS 3 phase 60 cycle

2—G.E. 700 HP 720 RPM 6600/4000/2300 Volt
Burke 300 HP 900 RPM 440/220 Volt
G.E. 200 HP 720 RPM 440/220 Volt
Ridgway 150 HP 1200 RPM 2300/440 Volt
Electric Machinery 150 HP 720 RPM 73 P.F. 440 V.
G.E. 125 HP 277 RPM 440/220 Volt
C.W. 100 HP 900 RPM 440/220 Volt
Fairbanks-Morse 75 HP 720 RPM 220 Volt
G. E. 60 HP 720 RPM 440/220 Volt

SLIP RING MOTORS 3 phase 60 cycle.

West. 150 HP 720 RPM 550 Volt
G.E. 60 HP 720 RPM 440/220 Volt
Allis-Chalm. 250 HP 600 RPM 440/220 Volt
Burke 100 HP 1200 RPM 440/220 Volt

ADJUSTABLE SPEED 230 Volt D.C. Motors

1—G.E. RF-18 90/120 HP 400/1200 RPM
1—GE RF-17 50/100 HP 450/1200 RPM
1—Reliance 1400-T 100/125 HP 300/900 RPM
1—West. SK-140 100 HP 600/950 RPM
1—West. SK-180 45/90 HP 475/950 RPM
1—Diehl 50 HP 400/1200 RPM
1—Reliance 1400-T 50 HP 175/700 RPM
2—Crocker-Wheeler 125-H 50 HP 175/700 RPM
1—West. SK-143 40 HP 500/1500 RPM
2—Reliance 461-T 40 HP 475/1500 RPM
1—Allis-Chalm. 35/70 HP 450/1350 RPM
1—Allis-Chalm. 25 HP 600/1800 RPM
1—G.E. CD-93 15 HP 500/1500 RPM
1—G.E. CD-103 15 HP 400/1600 RPM
2—West. SK-123 5 HP 300/1200 RPM enclosed

The Electric Motor & Repair Co., Cuyahoga Falls, O.

AVAILABLE IMMEDIATELY

One—410 h.p. **Riley "Ring Flow" 4 Drum Boiler,** A.S.M.E. 160#, full water cooled furnace for P.C., oil or gas firing, six years old, A-1 condition.

One—500 h.p. **Keeler "CP" Boiler,** A.S.M.E. 160#, full water cooled furnace for P.C., oil, or gas firing, two years old, A-1 condition, full steel cased setting.

One—**Riley Atrita No. 4 pulverizer** with geared turbine drive and 4 speed F.D. fan.

One—**Riley Atrita No. 3 pulverizer** with A.C. motor drive and 4 speed F.D. fan.

Full specifications upon request.

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Cincinnati, Ohio

STOCK SHIPMENTS

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1—INTERNATIONAL PD-40 Power Unit
60 H.P. F & M 3/60/2300—F & M Gen.
80 H.P. ATLAS—Belted
100 H.P. FULTON—Belted
2—55 H.P. BRUCE MacBETH NAT. Gas Engines
240 H.P. F & M 3/60/2300—F & M Gen.
2—300 H.P. F & M 3/60/2300—F & M Gen.
1—360 H.P. F & M 3/60/2300—F & M Gen.

STEAM

80 H.P. BALL 53 K.W. 125/250 Volt 3 Wire Westinghouse Generator
95 H.P. AMES-Unaflow
125 H.P. SKINNER—Center Crank
300 H.P. RIDGWAY 4 Valve 250 KVA 3/60/2300 Ridgway Generator

Complete Repair and Maintenance Facilities For All Reciprocating Machinery

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FOR SALE:

1—Moore Turbo-geared

GENERATOR UNIT

consisting of:

Type S-4 Moore multi-stage turbine driving a 100 KW, 80% Power Factor General Electric 4 wire, 1200 rpm, 220 volt, 2 phase, 60 cycle generator with direct connected exciter turbine designed to carry 100 KW with steam at 125#, gauge 50° superheat, 7½ pounds gauge back pressure, steam consumption 54.5# at full load. *If interested in this unit please apply with quotations to F S 244, 330 West 42 St., New York City. Power*

Condensing Turbine Unit

375 KVA G. E., 4 Stage, Form B, 200 lb. steam, 240 Volts, 3 phase, 60 cycle, 3600 RPM, equipped with S & K multi-jet condenser, without exciter, with two Goulds condenser pumps and common base, but without motor.

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK, DELAWARE

Re-built Motors and Generators

2—75 HP, 2200 V, **Fairbanks Morse,** 1800 RPM, 3 PH, 60 CY slip ring motor, direct connected to 500 GPM 3 stage 200' head pump.

1—400 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 450 RPM slip ring motor.

3—350 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 600 RPM slip ring.

1—300 HP **Allis Chalmers,** 3 PH, 25 CY, 440 V, 485 RPM slip ring.

2—250 HP **Westinghouse,** type CS1012, 3 PH, 60 CY, 440 V, 435 RPM sq. cage.

1—200 HP **Westinghouse** syn. 1 PF, 3 PH, 60 CY, 2200 V 600 RPM with direct connected exciter, 3 or 2 bearing.

2—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

2—150 HP **Westinghouse,** type CW, frame 1000, 2 PH, 60 CY, 440 V, 450 RPM slip ring.

2—100 HP **Westinghouse,** type CS, frame 754 C, 3 PH, 60 CY, 440 V, 870 RPM sq. cage.

3—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 1750 RPM sq. cage.

1—100 HP **Westinghouse,** type CCL, 3 PH, 60 CY, 2200 V, 1750 RPM sq. cage.

1—100 HP **Wagner,** type 26V5BP, 3 PH, 60 CY, 440 V, 860 RPM sq. cage

2—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 440 V, 690 RPM slip ring.

1—100 HP **Westinghouse,** type SK, frame 160, 230 V, 1100 RPM.

1—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 2200 V, 690 RPM slip ring.

1—75 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

1—75 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 720 RPM slip ring, 3 or 2 bearing.

1—75 HP **Fairbanks Morse,** type H, frame 165 C, 3 PH, 60 CY, 550 V, 900 RPM sq. cage.

2—75 HP, **General Electric,** type I, 3 PH, 60 CY, 220 V, 720 RPM sq. cage.

1—75 HP, **General Electric,** type MT, frame 337, 220 V, 3-60-1745 RPM.

1—75 HP **Lincoln,** type IQ, 2 PH, 60 CY, 440 V, 600 RPM sq. cage.

1—75 HP **Finn-Weiksel (Wagner)** ty. 26VRN, 3 PH, 60 CY, 220 V, 1200 RPM syn.

1—250 HP **Crocker Wheeler,** type CCM, size 151 H, 230 V, 600 RPM, DC

3—100 HP **General Electric,** type CD, frame 123, 230 V, 1200 RPM DC

1—60 HP **General Electric,** type CD, frame 115, 230 V, 850 RPM, DC

1—50 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 565 RPM

1—50 HP **General Electric,** Class 6, Form B, 600 V, DC, 600 RPM

1—50 HP **Ideal,** type SMS, 3 PH, 60 CY, 220 V, 1800 RPM, synchronous.

1—60 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 680 RPM

1—60 HP **C&C,** 230 V, DC, 250/1000 RPM

1—75 HP **General Electric,** type CD, frame 176, 550 V, DC, 250/1000 RPM

3—75 HP **Westinghouse,** type SK, frame 150, 230 V, DC, 1100 RPM

1—**Sprague** Dynamometer, type LC, 150 HP, 250 V, 2300/3500 RPM with new Toledo scale, no control panel.

1—100 KW **General Electric,** type DLC, 125 V, DC, 440 V, AC M-G set.

The Wente Electric Co.

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Est. 1903

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2200V. 60 Cy. 3 Ph. 180 Rev.
5000 KW. Vertical 60 Cy. 3 Ph. 4150 V.
Turbine with 12000 Sq. Ft. Sur. Cond.
6 New Fans—66750 CFM. 2" to 6" S.P.
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6 HOT METAL LADLES, 120 TON
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1800 HP. RED. GEAR 7.7 TO 1.0
5000 KW 60 CY. VERTICAL TURBO
LARGE QUAN. STONEWARE PIPE

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1— 80 H.P. Ames Boiler
1—100 H.P. Vertical Boiler
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1—150 H.P. Economic Boiler
1—250 H.P. Scotch Marine Boiler
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210 HP Stanwood horizontal A.S.M.E. code 125 lbs. WP complete with trimming.

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1—Chicago Steam Driven Air Compressor Size 14"—22" & 20"
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6—Boiler Steam Pumps
3—Horizontal Single Steam Engines
Also Turbo-Generator, Fans and misc. boiler house equipment. Full detail sent upon request.

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5—300 H.P. 2200 VOLT, 1800 RPM INDUCTION TYPE MOTORS.
Good condition, slightly used.

1—MT Frame 561 GE, 3 phase, 60 cycle slip ring induction motor with CR7012, DL 1762434 Automatic Control panel., one CR 0840-10 K-1925346—6 sec. Rheostat.
2—MTP Frame 561 GE Style 136271, 3 phase, 60 cycle slip ring constant speed induction motor 40° and CR7012D-1 seven point automatic starter.
2—Type "I" Form "M" Frame E-15 GE Style No. 16241, 3 phase, 60 cycle 40° slip ring constant speed induction motor and CR-7012D-1 seven point automatic starter.

Offered subject to prior sale.
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Write for prices.

General Steel Castings Corporation
Granite City, Illinois

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1—40 KW C-W Type CCD, 250 v. 1100 RPM.
1—45 KW C-W Type CCD, 250 v. 1100 RPM.
1—25 KW GE Type RC 250 v. 900 RPM Generator.
1—5 KW GE Type CD 250 v. M G Set.
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One (1) Turbo-Generator, approximately 1875 K. V. A., 3 Phase, 60 Cycle, 2,300 or 4,000 Volts, 150 to 200# Steam Pressure, 500° F, single extraction condensing or straight condensing with surface condenser. Send Serial Number, Age, and Specifications, Location and Price of Equipment loaded on cars ready for shipment.

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Engineers
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A good used 1,000 HP Water Turbine, operating on 200 to 230 ft. head. In submitting your offer, please give full details and specifications.

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For heating raw river water, for use in beater room of paper mill. In submitting your offer please give full details and specifications, and also capacity.

W-231, Power
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WANTED

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2—200 HP **Erie City Economic boilers**, 150# pressure
3—1200 HP **Stirling boilers**, 200# pressure.
3—315 HP **Lasker Adams boilers**, 200# pressure. Firerite stokers.
2—350 HP **Stirling boilers**, 200# pres., oil burners.
1—200 HP **Brownell locomotive boiler**, 150# pressure, stoker.

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2—407 HP **Erie City boilers**, 250# pressure, with stokers.
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1—2000 KW **Westinghouse condensing turbine**, complete, Jet condenser.
1—1250 KW **G. E. extraction turbine**, complete surface condenser, all auxiliaries.
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1—250 KVA **Erie Ball Corliss** engine generator.

1—250 KVA **Skinner uniflow engine.**
1—180 KVA **Ames uniflow engine generator set.**
1—250 KVA **Fairbanks Morse full Diesel engine.**
1—300 KVA **Fairbanks Morse VA full diesel engine generator sets.**
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1—Cochrane **feedwater heater**, 90,000# per hr., 10# pressure.

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Also

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Both in serviceable operating condition.

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received by Feb. 6th, to appear in the March issue, subject to space limitations.

Address copy to the Departmental Staff

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1" Vacuum Pump Governor.
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5" Drainage Tee; one 1 quart force feed lubricator pump.

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One Leacourtenay 5", 2 stage Centrifugal Pump, capacity 1000 GPM, 125 lbs. pressure. Guaranteed A1 condition. Can reduce capacity and pressure if necessary.

Immediate delivery from Chicago!

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IT'S CHEAPER TO MAKE VALVES LAST LONGER—THAN REPLACE THEM...

(... even if you can get replacements)

» *Investigate* DEXTER EQUIPMENT for Reseating Globe, Gate and Pump Valves

If you're up against the problem of increasing your power load now—if you can't wait for the time you'll be able to get power equipment to meet increased power demands—here's a practical suggestion: go after the leaking valves in your plant and get at least some of the added power you need by reconditioning your valves with DEXTER EQUIPMENT.

In one plant recently an 18% increase in power load was attained just by checking and reseating leaky valves, the reseating being quickly and economically handled with DEXTER VALVE RESEATING EQUIPMENT. There were no delays waiting for new valves—no expenses incurred for new valves—*and an 18% waste was converted into 18% more power.*

You have the same opportunity right now, to recondition your globe, gate and pump valves with Dexter Equipment and eliminate losses, make your present valves last longer and get the additional power you need for production in your plant.

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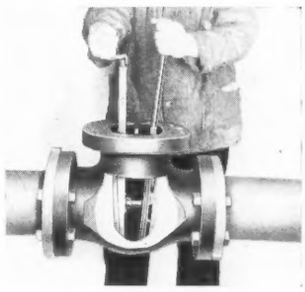
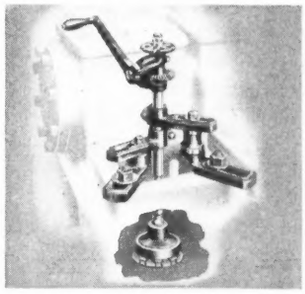
Get All Facts Today

Outline your problem—Ask for our recommendations. Send for Catalog No. 40 giving valuable information on valve maintenance.

Dexter Globe Valve Reseating Machine



Dexter Gate Valve Reseating Machine

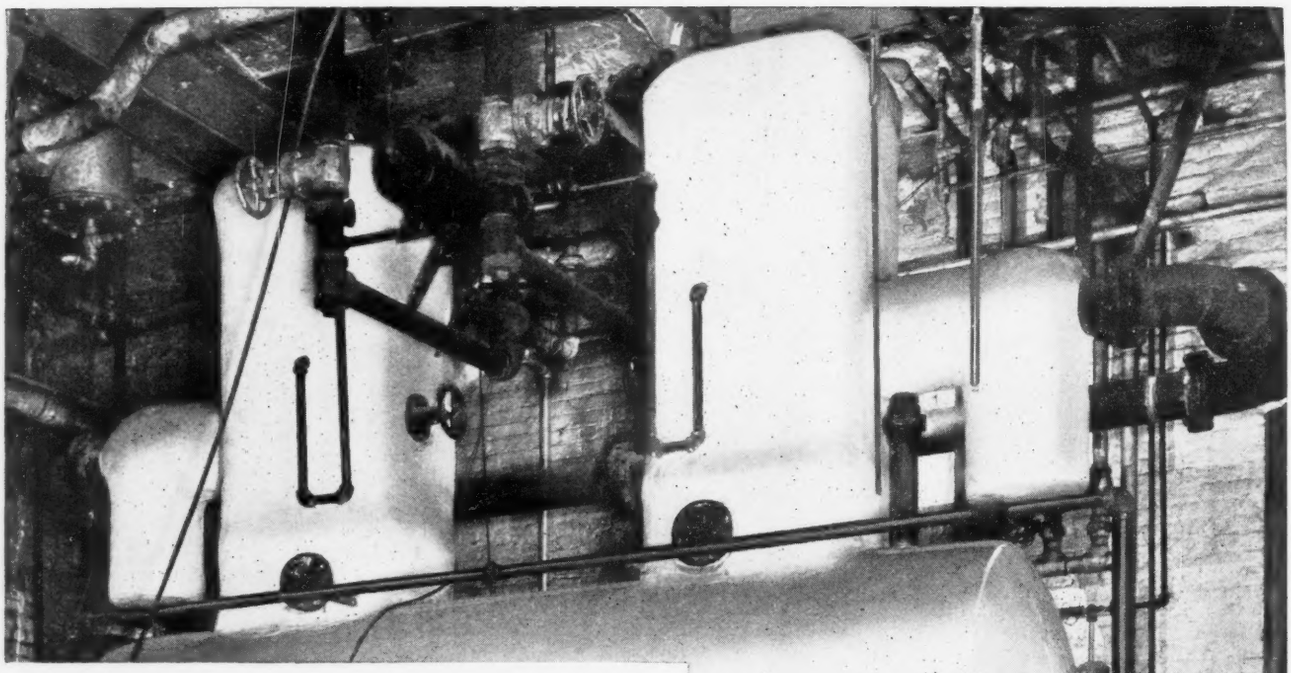


Dexter Pump Valve Reseating Outfit

DEXTER TIPS ON HOW TO MAKE YOUR VALVES LAST LONGER

Make regular inspection of your valve.
Check for leakage.
RESEAT & REGRIND all leaky valves with DEXTER EQUIPMENT.
RESEAT improperly seated valves the right way — with DEXTER Equipment — don't force them.
Clean all valves and pipe lines before installation of valves.
Keep valves closed during installation so dirt cannot enter.
Don't force opening and closing of valves with levers or wrenches. Properly seated the hand wheel is all that's required.
Open and close valves slowly.

The LEAVITT MACHINE CO.
ORANGE, MASS.

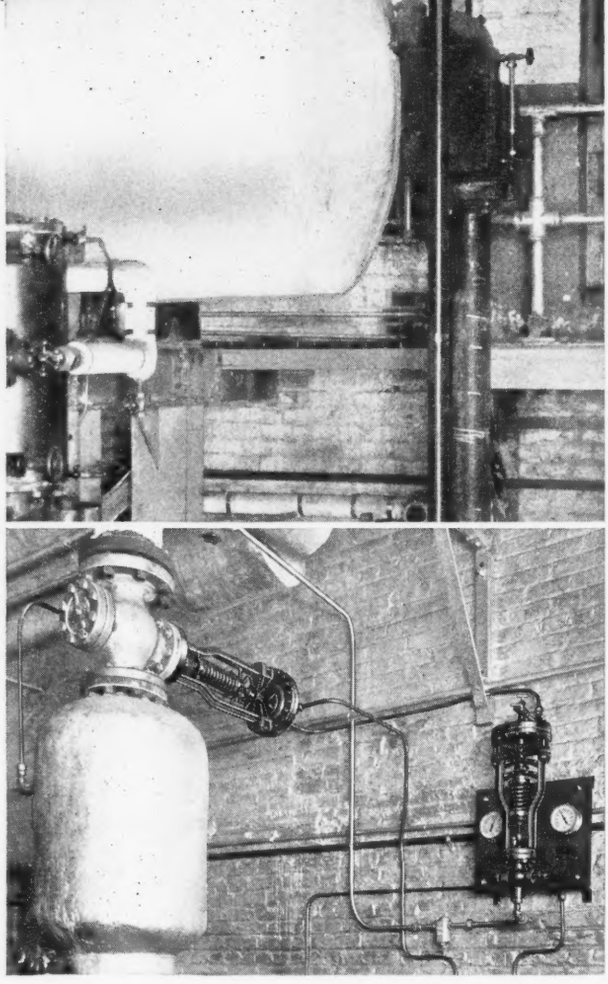


Swartwout Feed Water Heaters help your plant to deliver full power capacity, keep maintenance low, help save fuel

MAINTAINING full plant capacity is your most important responsibility these days. Don't neglect the vital "supply line" of oxygen-free correct temperature feed water for your boilers. Engineered to your requirements, Swartwout Heaters assure you lower fuel consumption and less trouble from scale and corrosion. A variety of combinations of size, style and storage capacity are available. *Guaranteed quality feed water* is backed by Swartwout's high standards of engineering, workmanship and materials.

Harnessing steam is another job you'll do profitably with Swartwout Equipment, whether it's pressure reduction, differential control or/and desuperheating. Lower photograph shows Swartwout Reducing Valve and Type CPM Master Control operating on an unusually difficult pulsating demand from an engine generator set. The wide range of adjustment on the Master Regulator makes it possible to "dampen out" these pulsations, effecting smoother service and less wear and tear on equipment.

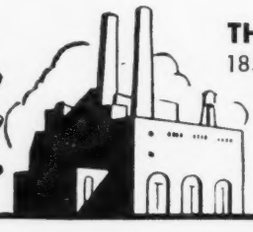
Simple design, rugged construction, easy adjustment features make Swartwout Controls *always* dependable.



Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•



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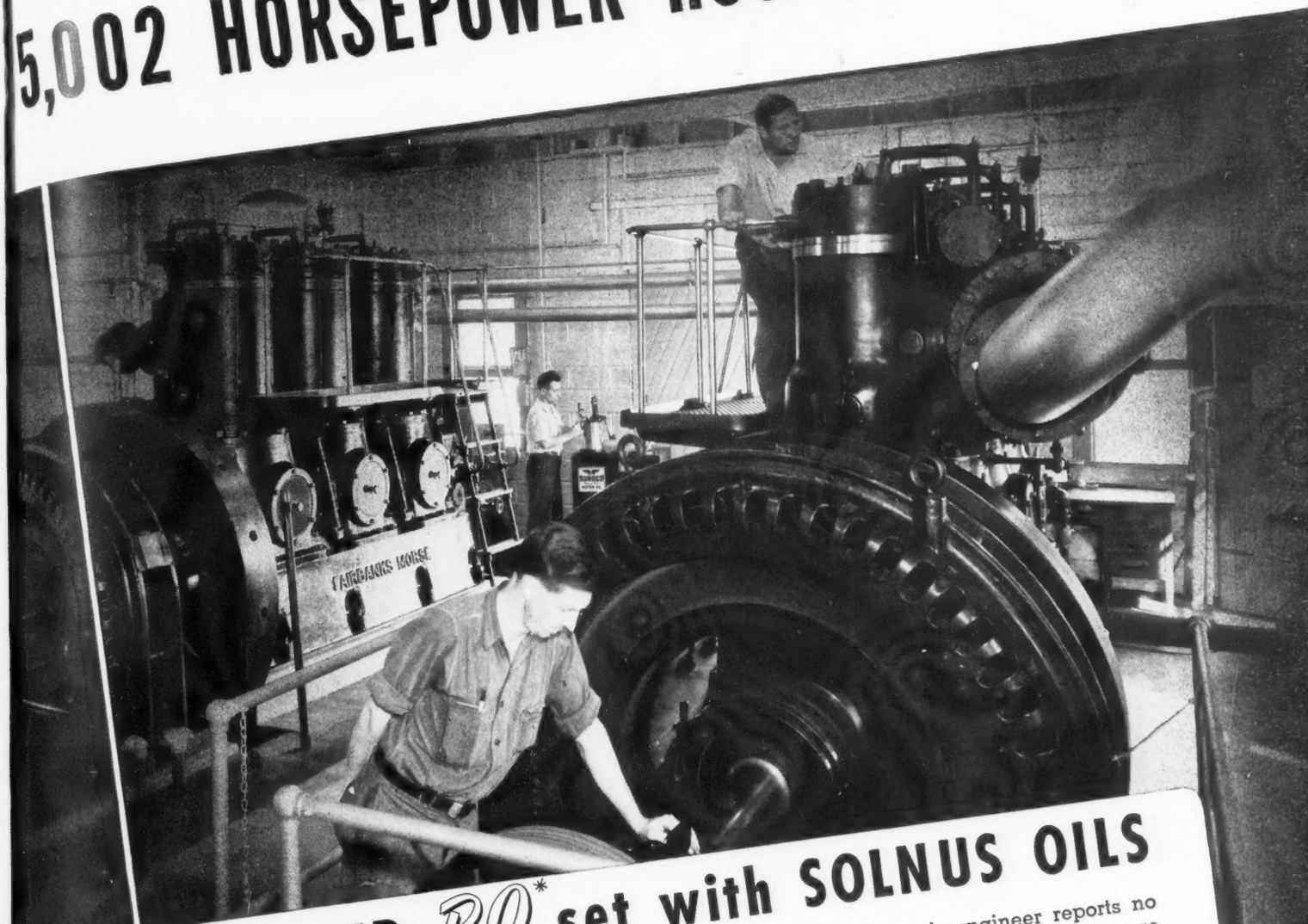
Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

5,002 HORSEPOWER HOURS PER GALLON



HIGHER P-Q* set with SOLNUS OILS

This diesel owner knew from past experience that of all the lubricating oils he had used, Sun SOLNUS OILS were first in performance.

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That's a mighty high P-Q* (Performance Quota). How close does the record of your diesels approach it? Why not take advantage of the outstanding qualities of SOLNUS OILS, the modern diesel oils that are

- **WHOLLY DISTILLED**
- **NEUTRAL IN ACIDITY**
- **DURABLE**
- **LOW IN CARBON CONTENT**

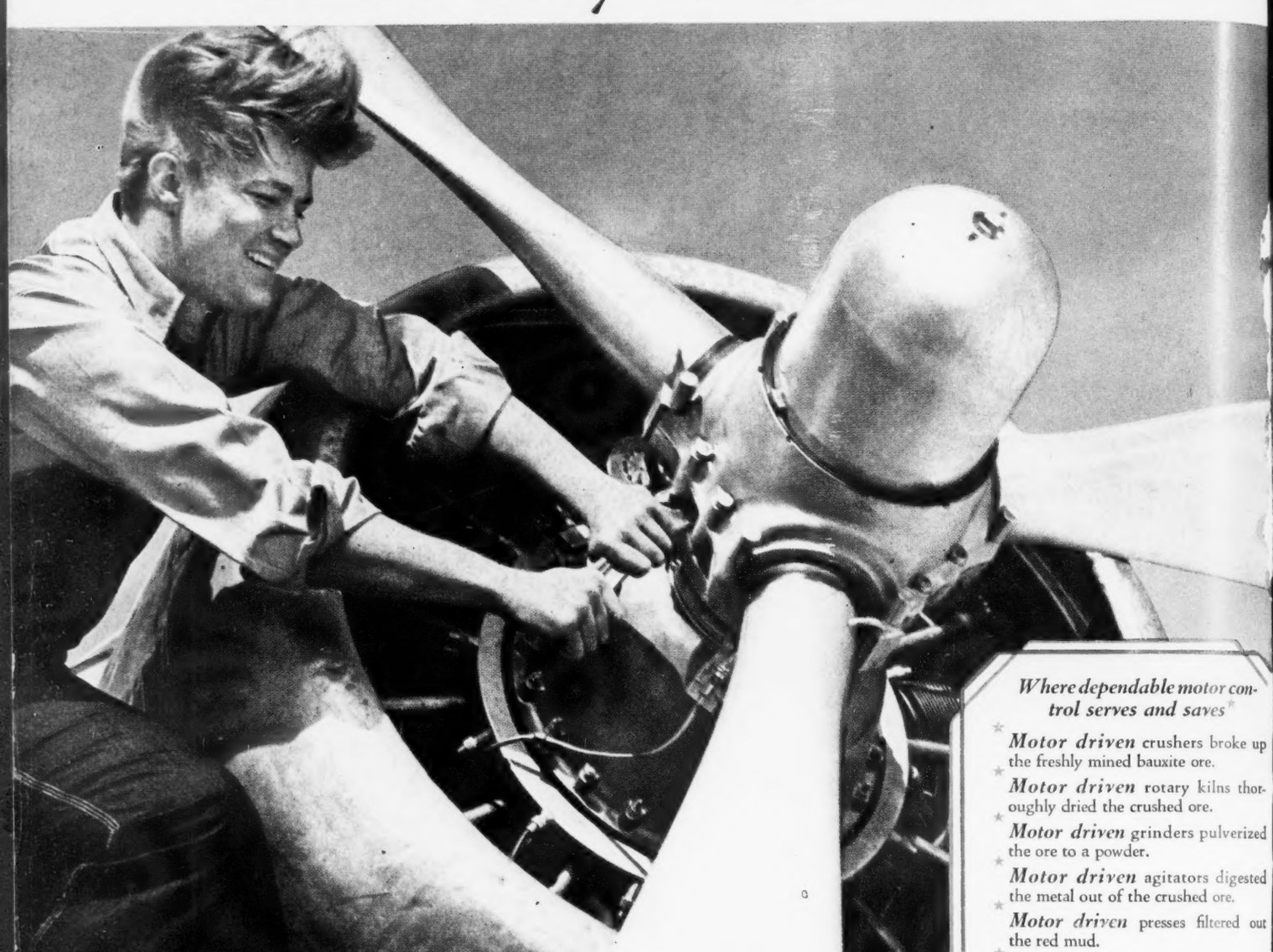
Call in a SUN "Doctor of Industry"—a diesel lubrication expert—for specific recommendations. Write SUN OIL COMPANY, Phila.

Performance Quota

SUNOCO

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

From Clay to "Contact"



Where dependable motor control serves and saves

- ***Motor driven*** crushers broke up the freshly mined bauxite ore.
- ***Motor driven*** rotary kilns thoroughly dried the crushed ore.
- ***Motor driven*** grinders pulverized the ore to a powder.
- ***Motor driven*** agitators digested the metal out of the crushed ore.
- ***Motor driven*** presses filtered out the red mud.
- ***Motor driven*** pumps conveyed the clear solution to precipitation tanks.
- ***Motor driven*** agitators threw the aluminum out of solution.
- ***Motor driven*** equipment produced the aluminum hydroxide.
- ***Motor driven*** cranes tapped the furnaces and ladled the molten metal into silvery pigs and ingots.
- ***Motor driven*** mills rolled the blooms.
- ***Motor driven*** shears cut the blooms into billets.
- ***Motor driven*** profiling machines shaped the blades.
- ***Motor driven*** millers and grinders trued the propellers to their ultimate perfection.
- In addition, scores of motor driven pumps, fans, conveyors, etc., played important supporting roles in the production of this vital product.

The making of an aluminum propeller is a serial story of Motor Control

Step by step, from the mining of the bauxite clay, through its refining into the metallic aluminum, through its melting, its casting, its machining, even up to the moment when the click of a Cutler-Hammer switch sets the finished propeller spinning, the story of this vital aluminum product is but a recital of one situation after another in which Cutler-Hammer Motor Control now stands guard 24 hours a day against delays and waste in America's all-out drive for security. These are trying times . . . days and nights in which unprecedented demands are made upon every type of industrial equipment . . . days and nights in which machines and their motors are pressed for ever increasing output . . . days nights in which thousands of men learning as never before the *plus* valu*dependable* Cutler-Hammer Motor trol. CUTLER-HAMMER, Inc., St. Paul Ave., Milwaukee, Wis. *Asso* Canadian Cutler-Hammer, Ltd., Toro

CUTLER-HAMMER
MOTOR CONTROL
C-H

1892–1942
50th ANNIVERSARY

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